The Linear System of Technological Products
Problems and Possible Solutions

a research by Alessio De Marchi

INTRODUCTION

The world we live in is spoiled and devastated, natural resources are scarce, biodiversity is constantly reduced, the globe is heating up on the outside and rumbling on the inside and we continue filling our lives and thoughts with material nonsense. This system is in decline and new ways are needed. The best way is yet unknown, however, in this booklet I want to look at possible approaches for making the whole system more harmonious.
Some ideas and models of what might be done are proposed and certainly any new input or information that may help in creating a new flowing and dynamic system is welcome.

Based on personal experience, I'll be approaching the issue considering gold and precious metal recovery as the main goal. Metals and gold in particular have followed, perhaps led, the story of humanity, from the “Stone Age” to the “Bronze Age”, the” Iron Age”, the “Rush for Gold” the “Coal Age”, the “Oil Age”. We've already extracted. All there is has already been extracted. It now appears we are entering the “Waste Age”.

Gold has been the eternal metal, the most precious and rare. It doesn't change in time, it's heavy and a calm, warm yellow material. Gold has always been the symbol of power, the metal of God. Because of its scarcity, symbolism and intrinsic properties gold is one of the most precious metals.
Along with the Platinum group silver is also considered a precious metal and has qualities even more useful than gold. This metal is less rare than gold, thus cheaper and through innovative design and accurately smithed can be sold up to fifteen times its market value.
Basically all the existing gold on the planet has been retrieved and extracted (just like oil reserves) The amount of existing gold is finite, just like everything on our planet. Man extracts everything Nature has to give. Now we must find a way to make the design circular, similar to the water cycle.

There is rarely any waste in goldsmithing. Anyone working with precious metals will not throw away even the sweep dust from the lab floor because it could contain some gold powder.
Goldsmiths even collect the water from hand washing because over time gold builds up in a rather toxic slurry.

Hence why are the gold and metals contained in electronic equipment thrown straight into the dump?
All production should be contained within closed cycles where every input comes from a bigger cycle and is the output of some other cyclic system. Every output must be an input to another cyclic system and the entire system should be as cyclic as possible.
This may appear a philosophical debate and partly it may be, however the planet we live on is round.

Section 1_
Problems Related to the Linear System of Technological Products

The overall Issues discussed in this first section will be the ever growing problems related to the linear system of technological products. Raw materials, in particular metal resources, are scarce and the mining industry is facing difficulties in retrieving exploitable sites. Remaining deposits are located in adverse natural conditions and metal contents are low and dispersed in vast amounts of other materials which make them hard to separate. Thus traditional mining extraction is increasingly expensive and environmentally unsound or dangerous.

SUMMARY
The biggest extraction companies have been observing their resources continually reducing every year at increasing speed. Now they must face ever growing challenges in the extraction of the few resources left. Therefore they must invest greater amounts of money in research to find economically rewarding ways to separate metals from ore, having to process increasing amounts of ore to retrieve decreasing amounts of metals. Conventional mining in fact, consists in literally digging out rock, grinding and leaching them with cyanide and other chemicals. The result is chemical slurry rich in metals which will be later processed and metals extracted through precipitation of metallic salts or recovered via electro winning process. This process causes enormous pollution problems and small mistakes can result in massive poisoning of aquifers, hence the populations living along river basins. Moreover evaporation of such chemicals liberated into the atmosphere and the simple fact that digging out immense holes in the Earth's crust is detrimental to the environment and can have uncertain effects on populations and animals.

FACTS
In order to have a concrete idea of the situation, let's take a look at Harmony Mines' key statistics for 2010, where the amount of ore milled has almost been constant or slightly increasing, however the volume of gold produced has shrunk by over 2%, yielding average 2.39 grams per metric ton. With production costs exceeding 1.000 Million U.S. $ (table1).

Table 1 – Harmony Mines South Africa Key statistics 2010

Operating performance		**FY10**	**2009**
Ore milled	000t	**17 963**	17 888
- Underground	000t	**8 519**	9 021
- Surface	000t	**9 444**	8 867
Gold produced(1)	kg	**44 433**	45 437
	000oz	**1 429**	1 461
– Underground	kg	**38 799**	41 871

	000oz	**1 248**	1 346
– Surface	kg	**5 634**	3 566
	000oz	**181**	115
Operating cost	R/kg	**195 162**	168 661
	000oz	**801**	583
Yield	g/t	**2.39**	2.54

Luckily enough the high market value of gold can still support this kind of industry, allowing mining companies and the workers and families involved, to gradually extract what is left and still hold on for one more year. Nevertheless each year they must dig a little further into their reserve, process just a little bit more ore to extract less and less gold and barely fit into the investors and market expectations. This is not to attack the mining industry, but to illustrate the situation of resources and how hard and expensive it is to extract gold .
Another problem to conventional strip mining is the use of chemicals on large scale and, no matter how safe and with all the precautions that may be taken, it is still is a very dangerous operation not to mention the social and environmental collateral damage involved on this scale of operation.

Big mining corporations are facing huge problems due to the low metal content in minerals, therefore some turn to less than ethical labor management. In fact there are illegal mines where over 40,000 people work every day. These people must descend over 2 miles under the earth surface to dig out the metal containing rock. The high number of workers, human resource logistics on 6 to 8 hour turns is very hard to manage and the employees must often live in the mine for days. Since the mines are in inaccessible areas and there are only a few elevators to move the workers from the bottom to the surface, food and drink corporations have made a business by providing over priced restaurant services where a can of soda can cost up to 20$.

The real question is: where is all this gold going?

Some of it goes to the banks to support the economy, although lately very few of the world' notable currencies are credibly supported by gold anymore.
Some of it goes to the jewelry industry, although the increasing cost of raw materials is blocking goldsmiths everywhere. Jewelry companies are closing down and leaving many artisans unemployed. For example, in the Valenza district (Italy), where the greatest goldsmiths used to work full speed for all the biggest names worldwide, many companies were forced to close down or reduce in size between 2009/2010. In addition most of the gold used in the jewelry industry is recycled from old collections and scrap from “buy gold” shops which may not know the source of the gold. It might be a family memory or a mug off the street. Eventually gold can often lead to crime because of its high economic and material value: a small piece can be worth a lot.
Other small quantities of gold are employed for medical and surgical purposes because of its antioxidant properties, from dental prosthesis, although ceramics are now preferred for aesthetic and structural reasons, to more delicate applications such as the stents employed in heart surgery and coronary catheterization and angioplasty. Metal, is also a great heat and electrical conductor, it can resist up to 1100°C (even higher in
certain alloys) and never oxidizes, therefore ALL connectors are gold plated: we're talking about 1 or 2 micron gold plating that makes every single connector, in any appliance, virtually become a gold mine.
Nonetheless silver is widely employed for it's antibacterial properties. Apparently, due to its high reactivity with oxygen, silver is able to oxidize, hence literally disintegrate the cell membrane of even the smallest and most dangerous microbes. Therefore there is an ample array of products on the medical market, containing silver as an antibacterial agent. Silver treated gauze and creams containing Ag+ ions are used in first aid and surgery to prevent bacterial infections. while detergents containing silver powders can greatly reduce the number of bacteria in the wash, hence improving hygiene. Nevertheless silver coated toothbrushes can greatly improve oral hygiene as well by reducing development of bacteria in the mouth.

Silver is the element with highestdegree of reflection and has been used for centuries in the making of
mirrors; Not to mention its marvelous wavelength that makes it appreciable for making the highest quality flutes.
Finally silver is also the metal with the highest electrical conduction property and is currently used in making all electric and electronic equipment.
Finally most of the gold and precious metals, where demand is increasing, is used in the high-tech industry: hi-fi, cell phones, radios, TVs, cars, monitors computers, i phones, chargers, and so forth... any kind of electric or electronic equipment contains metals. One cell phone alone is made out of about 94 elements from the periodic table. At the end of its life cycle all of this material is summed up under the definition of WEEE (Waste Electric and Electronic Equipment) or commonly called e-waste.
This kind of waste is rather complex and contains heavy metals and toxins which make it dangerous.
In addition, all the special high-tech equipment released into space from the early 60's is now polluting space with orbiting clusters of gold containing trash. I was once shown a sheet of gold about one meter by one meter, thinner than a sheet of paper.. The sheet was about two microns thick and was covered with microscopic holes punched out in a pattern. The sheet was pure gold and apparently it was used as external coverage for space landing modules...

Section 2
WEEE Management and Eco Crimes

Exhaust technologies mainly consumed in the U.S.A. and the E.U. are not collected at all and are deposited in land fills or stay in people's houses, stored in the cellar, or worse, this waste gets shipped overseas and dumped in a developing country, where waste management laws are not so strict. Since the first computer was invented, technologies have developed at extremely high rates, producing uncountable quantities of trash. One of the biggest problems is that the toxins and chemicals contained in scrap electronics are dispersed in the environment. The other problem is that we are literally throwing away tons of materials and precious metals.

WEEE SUMMARY

The first consideration about WEEE is that some parts may still be working and it could be worth refurbishing those before further processing. On the other hand this requires disassembling, separation and testing, all of which could become rather expensive operations depending on the country laws and the level of know how required to recognize and separate the valuable parts. Thus the companies doing this in Europe and the U.S.A. ask for a contribution for each computer recycled. The result is offputting for those who would like to dispose correctly of their e-waste. New laws have pushed companies to hold producers responsible and now they must take back discarded technology, yet consumers may buy a new computer without handing in an old one.

Finally the best solution economically is to pack this trash into a container and ship it where waste management laws aren't that strict and where the local mob is most willing to take care of the problem for some inconspicuous reward. This linear path of materials from the quarry to the dump has been going on for over 50 years now, reaching outrageous levels. Most developing countries are filled with first world WEEE and don't really know what it is or what to do with it. So here is how they handle the problem: in Africa they prefer burning it to the open sky to reduce the volume. They certainly obtain their goal but at what cost? Polluted air, polluted water and polluted soil. We can just imagine the consequences of such irresponsible behavior caused by ignorance. In India and China instead, aware of the precious metals to be recovered leach the circuit boards one by one, bare handed, in buckets full of industrial sulfuric acid or direct smelting in pans of hot mercury in order to retrieve a few grams of precious metals.

During the Basel Convention, 5 MAY 1992, countries signed a ban that defines illegal any toxic waste exportation. In 1999 the parties were 130. All European countries have signed it, however many other countries amongst which the U.S.A., known to be the biggest consumers on the planet, still hasn’t signed it yet today.

FACTS

The first problem with WEEE is collection. No one knows where to throw away their old computer and the shops take it back, unwillingly, only if you buy a new one in their shop. Companies, schools anyone replacing their computer, wind up storing the old working and broken stuff in the basement.

Storing it away indefinitely or worse disposing of it in the regular trash bin (illegal). Here are some numbers referred to an old survey before the year 2000. Based on the increase in quality and quantity of average technologies, possessed by the average person, and the shortening lifetime of high-tech equipment, we can easily suppose these quantities have greatly increased. These statistics are only estimates for computers alone.

173.000 tons Estimated daily e-waste production yes hundreds of thousands!
133.000 Computers discarded daily in the USA alone
650.000 computers produced daily around the world

The numbers are so large they are difficult to imagine. Unfortunately, in other parts of the world there are many people who have a different perspective on the issue and know exactly what enormous mountains of toxic e-waste look like, and have to cope with it day after day in the worst of ways.

CONSIDERATIONS

The United Nations have listed Eco-Crimes among the major emerging crimes on the planet. Apparently criminal waste management must be pursued by organized groups. Since this sort of crime involves massive volumes and international logistics, there must be a minimum of three people in charge: the commissioner finding who needs to get rid of the toxic material and doesn't want to spend to have it disposed of correctly; the transporter, who organizes the logistics and prepares the international logistics and is willing to captain a ship waving a false flag; and the disposer who receives the waste and disposes of it, totally disregarding international waste management laws and often corrupting local governments. The masterminds will have to employ hundreds of workers in order to quickly handle such volumes, minimizing the time of transportation, loading and unloading. An organization of this kind must be structured at international level and, as often happens, criminal organizations do not limit their actions to one business only, therefore profits from eco criminal business will most likely be reinvested in other unlawful trafficking.

The effects of this new type of crime are yet unforeseeable, while on a short term basis the repercussions on the local environment and the communities living in the territory are visible. Long term effects are yet to be studied and quantified. Also the long range consequences of natural resource depletion can result in mass migration of populations and animals, therefore inducing other types of crimes. If the pollution of the water, for instance, were to kill all the fish in a certain area or force them to migrate, the local populations living off of fishery would have to migrate as well towards a richer country or resort to other kinds of business such as piracy or drug and human trafficking.

Section 3
Efforts and Research for Safer Mining

SUMMARY
Many innovative mining techniques have been developed throughout the last decades. One of the most interesting is bio-mining. Although the process implies recurring to regular ore deposits, bioleaching replaces the use of cyanide with bacterial microorganisms, cultured in engineered environments, to extract precious metals, such as gold, from ore in which it is embedded. As an alternative to smelting or roasting, miners use bio leaching when there are lower concentrations of metal in ore and an environmentally responsible, method is needed. The bacteria feeds on nutrients in minerals, thereby separating the metal that leaves the organism's system; then the metals can be collected in solution to be later retrieved through salt precipitations and electrowinning processes. These bacteria occur naturally in mines, and have existed for millennia. Apparently also the Romans knew about leaching bacteria and used to promote the formation of bacterial streams in mining facilities as catalysts to speed up the work. However this method, although more environmentally friendly is too slow for this demanding world and already the Romans had soon abandoned bio-leaching in favor of roasting and smelting, more expensive and pollutant but certainly fast enough to fulfill the increasing request for materials.

BIOLEACHING
Bio leaching works thanks to special microorganisms, which, feeding on mineral deposits, are able to extract metals from the rock. This completely natural smelting system is caused by the combination of two types of bacteria: the leachers, which secrete organic acids similar to sulfuric, able to separate metal from ore as sulphates, and the oxidizer bacteria, using a chemical reaction called oxidation, which convert metal sulphite crystals into sulfates and pure metals.
Already many projects, engaged in developing countries, mainly in South America, have proved how bio mining, mainly adopted in copper extraction, can be a way towards self sustaining, independent, slow and safer mining industry. This has allowed reinforcement of local economies and governments, producing safe and healthy work and living conditions. Moreover bio leaching produces less air pollution. In addition bacterial cultures grow and become more efficient through time because the living organisms adapts to the environment feeding on selected ore.
This simple, effective, and low cost method offers a smart choice for developing countries. About 20% of the extracted copper in the world currently comes from bio leaching and increasingly more companies are adopting this technology. In addition little damage is done to geological formations, since the bacteria occur naturally. Copper is not a precious metal although it's very useful, it's main quality is in its electric conductivity that makes it appreciable in any electric and electronic applications. In addition, since silver is often a byproduct of copper extraction due to the affinity between the two metals, which are often found in alloy.
Here is a table of current bio leaching facilities in Chile (table 2).

Table 2 - Current Copper bio leaching operations in Chile

Mine	Production, tons/year
Heap leaching	
Lo Aguirre	14,000
Quebrada Blanca	75,000
Cerro Colorado	100,000
Zaldívar	150,000
Iván-Zar	12,000
Andacollo-Cobre	21,000
Dump leaching	
Chuquicamata	over 15,000

Nevertheless if the only goal is profit, unfortunately bio-mining, although cheaper and safer, is still too slow for this fast paced world and cannot answer alone to the increasing demand for raw materials. In fact the only drawback of bioleaching is its lower efficiency in terms of speed, caused by the low temperatures of the operation, which dramatically affect chemical reaction rates.

In any case it has been proven that bio mining can be effective in re-processing spent ore residues in ancient mines, this could allow local communities to take advantage of what was already there and further exploit ancient mines that hadn't been thoroughly exploited on account of limited technologies at that time. Haste and abundance of metals allowed miners to extract only a certain percentage of metals from the ore. Hence today, with improved technologies and, with the help of invisible miners, which will patiently eat on the rock at a microscopic level, spent ore can be profitably reprocessed while still retrieving some metals.

LEACHING WITH FUNGI

Other researches have developed leaching methods involving fungi, there are several species discovered that can be used for bio leaching. Fungi can be grown on many different strata, as with electronic scrap, catalytic converters, and fly ash from municipal waste incineration. Experiments have shown that two fungal strains (Aspergillus Niger, Penicillium simplicissimum) were able to mobilize Cu and Sn by 65%, and Al, Ni, Pb, and Zn by more than 95%. Aspergillus Niger can produce some organic acids such as citric acid, thus suitable for bio leaching sulfides. There is wide concern to find new low energy, safe, and environmentally friendly ideas to separate metals from bulk materials, focusing on the new ore resource: e-waste. But research is long and expensive therefore we must all work together and cooperate at all levels to find better, natural and peaceful solutions to our rush for materials.

ELECTROWINNING FILTERS

Others still are working on electrochemical systems able to drive and separate metals from anode slurry to special cathode filters, separating all the different metals in one single low energy process, involving the natural electronegative values of elements.

Section 4
Project Objectives

The project is to design a system in which WEEE becomes a safe, reliable and infinite resource of metals and in particular precious metals .
The main goal is to obtain:

1) Reduction of the need for traditional mining by promoting the use of regenerated metals.
2) Reduce exhaust technology content in landfills,
3)General awareness over the issue,
4) Creation of safe disassembling facilities,
5)Refurbishing of working parts to create a second generation technology market,
and safe metal recovery from scrap

The goal of this project is to evaluate a system in which WEEE is considered a sound and reliable alternative to rock mining, creating the concept of urban mining.
Extracting precious metals from scrap technology is very difficult and is becoming increasingly more difficult as the industry makes smaller products using new technologies that allow the reduction of quantities of gold needed to print circuit boards and plate contacts. However studies have demonstrated that 1 metric ton of selected circuit boards can yield from 80grams up to 1.5 kg one and a half) of pure gold, not to mention all the other metals contained.
This is the specific data of average metal contents in WEEE, updated in November 2011 according to Tetronics statistics

DDIntegrated Circuit (IC) Sweeps (Au 200-3500 ppm, Ag 0.2-3%)
DDMultilayer Ceramic Capacitors (MLCC) (Ag: 1-15%, some contain Palladium 0-17,000ppm)
DDRecovered IC Copper Powder (contains Au 50-500 ppm)

Subject to waste availability, and specific quality of the input (7k–100k $/ton) are making metal regeneration from waste streams an increasingly profitable industry.

Au/Ag/PGM	30g-1500g	kg/ton
Cu	160	kg/ton
Fe	40	kg/ton
Sn	25	kg/ton

SUMMARY
WEEE is one of the greatest environmental challenges because of the toxic elements contained; however it also contains precious and valuable metals. The biggest problem is they're all mixed

together and really hard and expensive to separate. Nevertheless the increasing price of raw materials is starting to make the work worthwhile. At the same time, as previously discussed, another problem is how to find all of this material, gather it and select it for manageable metal recovery. Anyway, although expensive and inconvenient, there are mainly two companies able to recover metals from scrap electronic waste in a safe and environmentally friendly way one in Belgium and the other in Japan. These are enormous, highly advanced and extremely expensive structures... The fact is that they are working at only 50-60% of their capacity and are so eager for WEEE to process they are willing to buy it from whoever is able to collect it. Therefore the pertinent issue is not so much how to safely treat the waste rather how to create an effective, efficient, low cost collection system such as promoting general awareness, gathering campaigns, door to door WEEE bins.

FACTS

Certainly, compared to mining it is a lot more difficult and expensive to process e-waste due to its high toxicity, however there are companies around the world able to do it in the safest way possible. These refineries employ the ultimate technologies for safe refining in big expensive plants where pyro, hydro and chemical-metallurgical methods are used for the separation of metals from waste stream. A large portion of the plant is a smelter furnace and all the rest is a fume filter system that allows recovery of all exhaust fumes hence the emissions of the plant are fresh air and clear water and metal and precious metal recovery There are currently two main refineries in the world able to safely process WEEE retrieving pure metals. However new technologies are under development. New plasma enhanced techniques,for instance, can retrieve up to 95 – 98% of the metals contained in WEEE and smelt all the residue containing toxic substances into a vitrified and virtually inert slag, thus minimizing airborne emissions.

Chapter 4
Research and a Few Ideas Worth Considering

In order to avoid dispersion of chemical and toxic substances it is necessary to make sure the processing happens in a sealed area. The same process must be as circular as possible; therefore all the system outputs must be reintegrated into another similar system.
This could seem philosophical, however all over the world landfills are filling up quickly, so quickly, in many places the quantities are overwhelming. Not only future generations, but this one are experiencing shortages of resources: water air, mineral (earth).
Here I will propose some ideas and models I've been thinking about. Debate and suggestions are welcome. Based on my experience gold and precious metal recovery will be my main focus. Metals and gold in particular have followed (and perhaps lead) the story of humanity, from the “Stone Age” to the “Bronze Age”, the” Iron Age”, the “Coal Age”, the “ Gold rush”, the “Oil Age”., We've been gutting the planet for ages consequently we are entering the “Waste Age”, as that's where all our resources are.
Waste is kept as minimal as feasible in gold smithing. Even the sweep dust from the lab floor could contain some gold powder. By contrast consider the quantity of gold and metals contained in electronic equipment which go straight to the dump.
As a goldsmith the water from washing hands is collected because over time gold builds up even if in toxic slurry.
All production should be contained within closed cycles where each input comes from a bigger cycle.Every output must be an input into another cyclic system. Essentially the entire system should be as cyclic as possible.
We now know where to look for what we need, but what can be done when it's all mixed together?

As previously mentioned smelters have the need for a continuous feedstock of high metal content scrap. However exporting whole electronic devices is the first problem due to the volume of such stock. To be cost effective, waste needs to be pre-selected before smelting. most effective way to separate the various parts is by hand, however this is time consuming. Many grinding and sieving systems have been tested but apparently up to 75% of gold powder is lost if the system isn't correctly engineered. What solutions might there be?First green design should be obligatory in order to make parts easy to disassemble. Hence disassembling plants are necessary and although many already exist, the real problem is collection and general awareness over the issue.
This means finding a way to make people return their electronic waste. In Italy it is against the law to dispose of electronic waste in the regular trash bins/dumpsters, yet there are no indications where to put them. Supposedly they are to be returned to a local recycling center, usually 10 km from outside the city within business hours. For private individuals it is free, while companies are expected to pay. As a consequence most electronic waste is stored in the cellar or disposed of at night in a neighbors' trash bin/dumpster. Instead of asking for a contribution, coupons for each electronic device turned in,could favor promoting retrieval. This would encourage people to salvage unused electronic items. For *x* number of coupons a discount is available on certain products. The Idea is to offer discounts mainly on local waste taxes, electronics and jewelry.

This means a coupon for every electronic device saved from incorrect disposal rather than a coupon for every dollar spent. General awareness will eventually realize that although the price of sustainable jewelry for example might be a little higher than average, discounts are available for daily waste management.

National and local campaigns for advertising sustainable jewelry and regenerated precious metals and trash selection as part of a closed cycle should be encouraged. Such campaigns would be integrated in educational programs in school study plans all throughout the World. Subjects would include construction and safe disassembling of typical technological products, structure of typical IT systems, recognition of valuable and reusable parts, testing, assembling of II generation technology, labs and internships.

The idea is to stat with a local pilot project and see the results of a massive WEEE collection. Measurements made after treatment in local existing pre-treatment plants to observe the amounts of retrievable metals would indicate how to plan further movements.

1 Sieve selection of metal containing powders
2 Closed circuit pan collection to select metal containing powders.

However reaching the point of bulk separation and first level separation and refurbishing and train young professionals could already make a great difference.
The Economist estimates of world Technology consumption in year 2009 are

Cell phones
contracts every 100 people

1	United Arab Emirates	232,1
5	Hong Kong	179,4
17	Italy	174,0
30	UK	130,6

we can notice that in all of Europe part of South America and increasingly in the East, technology consumption is growing and every person has one ore more cell phones and at least one out of two or three people has a computer.

Computers
computers every 100 people

1	Canada	108,6
5	UK	90,7
7	USA	84,4
26	Italy	49,6

Space Vehicles
by country and all of subordinate missions

2007-2010	
Russia	108
USA	75
China	36
France	22
India	10
Japan	8
Iran	2

Considering these are only estimates of the technology in use and that technology rapidly

becomes obsolete, can give us the idea of the size of the issue: all of these technological objects will soon be upgraded, and the old one? Personally, I wind up changing cell phone at least once a year, because I brake it or loose it, I know people who have had the same phone for over 7/8 years as I know of people who change it every new model. I worked several times as salesman in big shopping malls selling cell phones and satellite TV... Every single day I'd sell from 4 to 20 telephones... imagine: and this was one shop in a 1Million people city in Italy, if we look at the issue from a distance e can easily imagine what a mess it is on a global scale since each phone sold is one to get rid of! Same for computers.
And what about satellite TV? With all the decoders, the dishes, the cables, the satellites and the waste exhaust of space launch, not to mention the microwave pollution.
Courses in school teach kids how to use a computer, children have cell phones as early as age 8 and there is no education on how to get rid of your old one, the dangers and the further life your technology can produce.

Further considerations should be made on the use of internet where, although being very cheap and convenient for the user, each click on the browser corresponds to several blimping lights in some server, connected to some other server farm, maybe in another country: the signal of every click and page and research you make on the internet activates a server in a server Farm. Providers constantly upgrade and expand their farms to hold all the information available on the net and, although one single click isn't a big deal, multiplied by the number of clicks per day per person, these farms work full speed and new ones are built each day, consuming huge amounts of electricity and there is no estimate of the quantities of WEEE produced in maintenance and upgrade.

Chapter 5
Drafting a Cyclic System for Precious Metal Resources.

The final objective is to create a portfolio of precious metals suppliers. Therefore designing a sales package for each specific metal declaring its origin and assuring the environmental and social implications it has developed, would allow the final client to choose the origin of the metal used in their piece and the economic background it has sustained. The package can be acquired by companies for specific design projects related to the cultural, naturalistic or social realities the metal processing is related to,reflecting in the beauty of the precious jewel all the beauty it has brought along the way.
I sincerely believe that any jewel buyer can understand the deepest values this project can convey and how wonderful it is to have the luxury of a jewel withholding the smiles of the people who have worked on it all the way from the man who gathered all that WEEE in his thick gloves to load it in the truck, earning his family a dignified living; along with all other workers along the way, for example, the designer, and the goldsmith not to mention the joy of Nature restoring year after with its miraculous growth able to transform the contaminated ground into fresh oxygen. All of this in a simple choice made during purchase at the local jewelry store.

The sales of jewels could be extended by directing a part of the revenue to non-profit organizations around the world sustaining communities and people. Nevertheless specific design projects could be developed in this direction referring the design and the metal used in the collection to the related culture and country of origin.

FIRST PILOT PROJECTS
Example
I've already developed a project: *GoTo Jewels* in collaboration with *Umicore*, Europe's refinery, and *Stonehenge*, a Granite stone quarry in Santiago de Compostella in Spain, produced by *Karim Chennouck* in Valenza. The jewelry collection is inspired by the granite coming from the *Way of Santaigo de Compostella in Spain,* extracted carefully respecting the geological formation by well paid workers in a safe environment...moreover the granite used is only the waste produced from cutting stair steps out of slabs of rock. The metal comes from Europe's safest refinery. The design and production were engineered as a final project for Masters in Jewelry engineering at the Politecnico di Torino – sede di Alessandria in 2009.
The design and production steps have been achieved within 6 months from its start with promising outputs. The collection has appeared in many design, fashion and granite expos throughout Italy in Rome, Turin, Milan and Verona. Although also a promotional video was made, (see youtube: *GoTo Jewels*), unfortunately this specific project is temporarily on hold due to lack of funds for product advertising and marketing.

FUTURE PROJECTS
Lately, I've been discussing the idea of making a collection of *Mokume Gané* jewels, an ancient

Japanese swordsmith technique used for decorating *katanas*, made out of regenerated metals from the DOWA refinery in Japan.

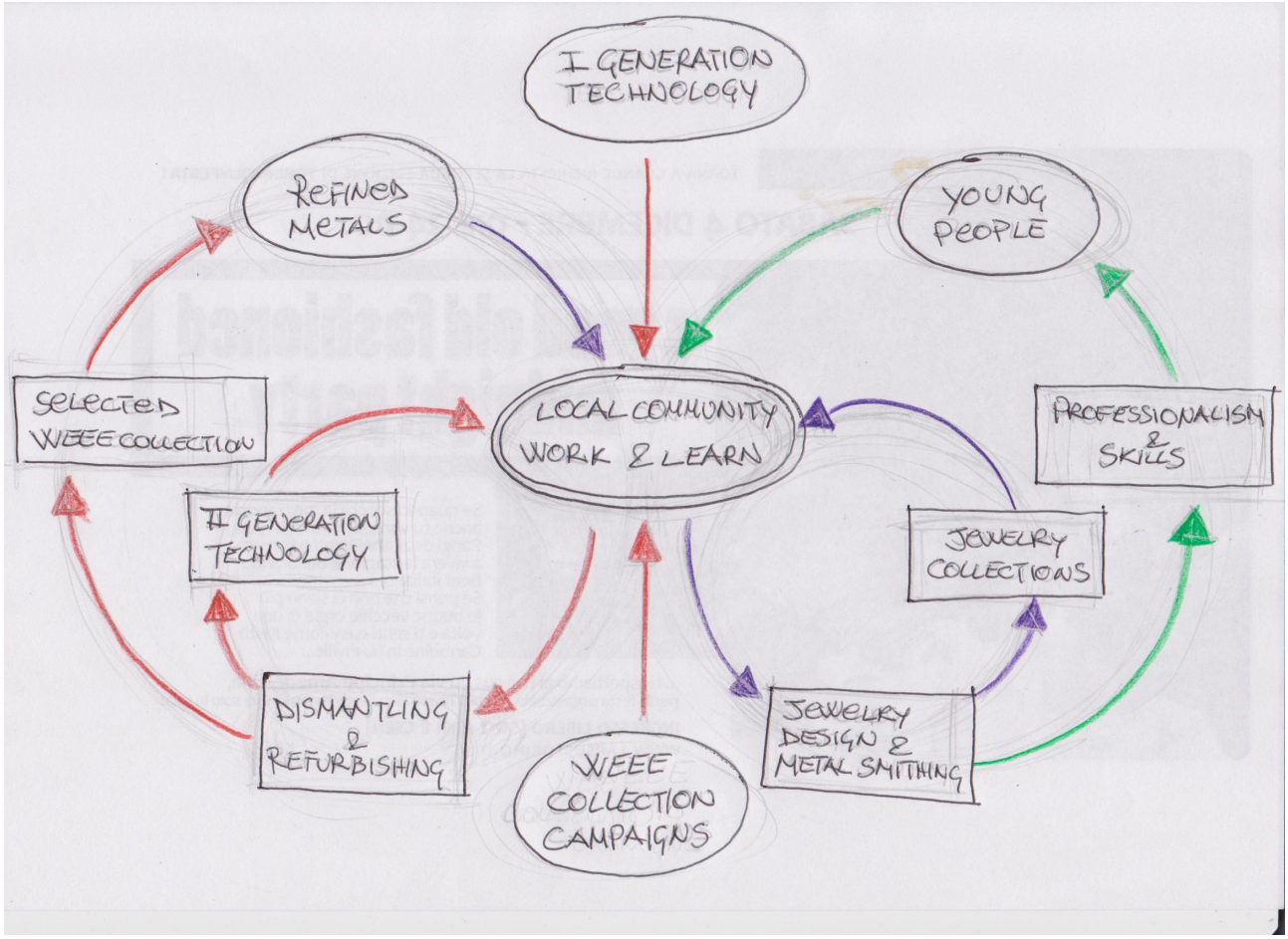
There could also be a market with the United Nations for the production of gadgets, jewels and any sort of metal objects made for corporate communication, and the entire production process would be a representation of their work world wide, from safer Labor (ILO) to reduction of eco crimes (UNEP, UN Habitat) and modern slavery and illegal smuggling of toxic waste and counterfeiting (UNICRI). All of this would be done through international collaboration on several levels, creating many safe work places worldwide, cleaning up the planet and reducing crime.

Another idea is to involve non profit projects in developing countries where there is a massive e-waste problem. Mainly in India where there is already a significant jewelry and jewelry making culture. Safe WEEE collection centers could be organized, promoting the collection of any electronic scrap.
Trade/vocational training schools could be made where instructions on how to safely handle and disassemble the parts as well as teach young outcast members of the community how electronics work and how to refurbish working parts. In this way a local second generation technology market could be created. These students would take classes in subjects such as math, history, local language and a second language in the morning and have a job in the “disassembling & refurbishing” plant or at the second generation technology “assembly & sales” facility in the afternoon. In this way students could proactively clean up their own land, get an education and get paid enough to maintain themselves and contribute to the family.
The non working parts would then be sent in containers (any better idea?) to the smelter in Europe or Japan for precious metal recovery. The metals recovered, minus the cost of shipment and refining, would return to the school facility to be reintroduced in the market through local jewelry producers who embrace the project, maybe promoting local emerging jewelry designers and artists.

The general idea is a system of mutual promotion therefore each one gets their just part out of the business:

Nature: for reduced need for strip mining and for the reduction of toxic waste.
People: because they will start living in healthier living and working environments.
Young people: they could easily find a part time job, get an education and develop creativity and professionalism.
Waste management: because of more work and workers, therefore more job places.
Smelters: because they would have a continuous and copious feedstock of selected quality WEEE
Jewelers: because, despite more expensive raw materials, the sales package is very powerful and can easily guarantee a 5x multiplier.
Consumers: because they are sure they are conscientious consumers, who, by buying jewels, can choose where to address their purchase: As informed consumers people can choose which businesses vision they are financing.
Governments: because they can finally demonstrate they are doing something for the people and the environment as well as find a solution to a long pending issue.
International Organizations: Because of better waste management, better control over waste related eco crimes and easier and transparent International collaboration.

ANNEX I
Draft of a local cycle



ANNEX II
Draft of an extended cyclic system (toxic waste still has to find a destination but at least it is safely stocked in one place)