Teacher/Trainers Manual

Working and Learning in the World of Cradle to Cradle

A Leonardo da Vinci Transfer of Innovation project

's-Hertogenbosch, The Netherlands, September 2012

Content

HANDBOOK

TOOLBOX ON THE WEBSITE

5. Process description; from game to reality
Including:
From simulation game to your own small project and the working place via Asking the right questions/game questions , creativity, brainstorming, CEBAM, project management

6. Learning methods; asking the right questions
Including:
3 Scene storyboarding method on asking the right questions
De Bono on creativity
Change management methods
Project Start Up method on project management
The Moon game on project management

7. Background material
Including:
Project website www.duurzaammbo.nl + links (also with critics on C2C)
C2C leaflet
Important literature
Important audio visuals

8. Business cases
Including:
Desso Airmaster and VET Koning Willem I College
DSM

9. Workshops and lessons
Including:
Workshop on Circular Economy (video and sheets)
Workshop on CSR and ISO 26.000 (video and sheets)
Workshop on decisive moments in C2C (video and sheets)
Lessons on sustainable energy (DMBO website)
Lesson on LCA?

10. Examples of C2C materials and companies
Including:
Student materials
Desso, DSM
Floriade

11. Our project work (restricted area)
Including:
Partners (with their decisive C2C moment)
Project management: meetings, marketing plans etc.
Promotion material: posters, leaflets
Communities of Practice
Discussion platform
Social media

HANDBOOK

Foreword
(Under construction)
By Michael Braungart
Focus on positive message, addressing young people and VET level.

Our guiding principles

Use of the term Cradle to Cradle
McDonough Braungart Design Chemistry MBDC is the owner of the Cradle to Cradle trademark. Environmental Protection and Encouragement Agency EPEA has the right to use this trademark and assists companies in the certification process. The C2C Product
Innovation Institute is licensed to certify products in accordance with the third version of the Cradle to Cradle certification chart, which is currently in progress.
In this manual we also use C2C as the abbreviation for Cradle to Cradle.

Positioning Cradle to Cradle
Surf to the project website to find an interview with Rudi Daelmans from Desso in which he gives his view where you can positioning Cradle to Cradle in relation to other concepts as sustainable development, green economy, circular economy etc.

How far do we go in this training; where do we stop
Participation in this course will qualify the trainees to:

- Raise a strong awareness of the C2C approach and the fact that economy cannot last the way we are thinking today.
- Understand what C2C is and what it is not, to understand the main principles of C2C, to learn the C2C language and to be able to transfer the message to others within their organization.
- Run a C2C course for their students or colleagues and to stimulate and to motivate the participants to look at the C2C opportunities with a kind of sense or urgency especially since the route is long.
- Implementing C2C thinking in education and in companies.
- To become a kind of ambassador for C2C in their own organization: an action oriented attitude.
- To have an idea of the basic principles for change needed to go more in the direction of a C2C approach.

This course will not qualify for giving C2C seminars outside your organization/company or give a train the trainer course.

Cradle to Cradle is a journey. There is not everything ready on a shelf like in the supermarket just to pick it up. People getting involved need to know this. It will not help just to consume C2C ideas and examples. There is need for being creative and innovative on your own.
C2C is a frame. It helps you to stay on a track and decide which action will lead you in the right direction.

Guiding Principles for the Handbook

In the Handbook we work with three chapters which answers the following questions:
Chapter 1: Why? - why do we need to do something different.
Chapter 2: What? – what is Cradle to Cradle (or in short C2C).
Chapter 3: How? – how to change for implementing C2C in your organization or institute.

Our education is competence based education. That means not only providing knowledge about C2C, but also providing skills to work with C2C and – very important – raising awareness and creating positive feelings about C2C. So, Competence Based Education = Awareness – Knowledge – Skills.

We provide material on the three C2C Principles:
- Waste equals food (mostly in Chapter 2).
- Use current solar income (on the website from KWIC courses).
- Celebrate diversity (in a workshop on Corporate Social Responsibility CSR and ISO 26.000).

Learning Process

The learning process will follow the C2C process which means moments of feedback, interactive, participating, action learning.

We use the simulation game Simplycycle as an important part in the learning process. To be emotional involved in the learning process ensures an intense learning process. Serious gaming provides a special learning experience. There is the opportunity to learn the presented topic in a relaxed, emotional and joyful way. This is a good form of active learning, the players of a simulation game have to try and test out best solutions. This is especially useful if also a change in perspective is needed to really understand a new concept (especially true for Cradle to Cradle). Participants can try out new patterns of activities and transfer the results into real life. The game situation also provides free space to learn in a self-determined way.
While playing a game participants enjoy themselves – a perfect surrounding for being creative.
The social embeddings also creates the potential to achieve results that no other method can match. It supports cooperation skills.

The main goal of the training is to teach your students to ask different questions. Especially industry will need employees asking questions in the new paradigm C2C.

It is not: how to do things right;
But: how to do the right things.
Otherwise we will only optimize the wrong things.

In our opinion all this needs that participants in your trainings become creative at the end of the day. There are several tools how to set up a creative environment, how to involve students in the learning process. Use them, let them get creative. For sure it should not be a frontal teaching lesson.

Attention: please keep in mind that it is no less than changing the mindset. This takes its time. Some students may react quick, others will need time to digest. Plan iterative sessions to get things repeated well.

Cases: we will use cases from different areas to demonstrate the concept. There are more in the material collection at the end.

We also like to start a process from theory and simulation to real work in the working place and/or a C2C project. Chapter 3 'How' is in this case very important, using the CEBAM method for change and implementation. On the website the process is described how you can start your own (small) C2C project in your company or institute. The most important lesson is this: just make a first step! (and the rest will follow).

Part of the learning process is *Setting of the room*:
Create a C2C environment (= creative, different examples of products resembling waste and food, humus from the forest to show re-cycling etc.)

Also *Take care of all learning Types:*
- Linguistic (Speaking).
- Visual (Seeing).
- Kinesthetic (hands on, learning with the body).
  And as you know..you learn the best when you have to explain to others what you just have learned!

The development of *Skills are provided in the course*:
- How to create the future (Chapter 2).
- How to arrange and manage a change (Chapter 3).
- How to set up and running a project (Chapter 3 and process).
- Team competence and cooperation skills (Chapter 2 and simulation game).
- Think out of the box, ask different questions, rethink paradigms (Chapters 1-3 and website).
- System thinking (Chapter 1).

You can think of the following *Program outline*:
The course is divided in 1,5 hour lesson pieces for teachers. You can also make a two day course out of the chapters and expand using the material on the website.

The *Provided Material* consists of a Handbook with the Chapters 1,2,3 and a website with a toolbox containing the simulation game Simplycycle, a process description (from game to reality), learning methods (focus on creativity and asking the right questions), back ground material (literature, audio-visuals), business cases, workshops and lessons (mainly concerning the two other C2C principles), examples of C2C materials and companies and finally a discussion platform for our community of practice members.

How to read the Manual

The teachers/trainers manual starts with guiding principles which are wise to follow.
The Handbook (not on the website) explains from *why* C2C to *what* is C2C to *how* to implement C2C.
Some important tools are in our toolbox on the website. It mainly concerns how to process from theory and simulation towards implementing C2C in your own company/institute, starting with your own small C2C project, which you can see as your first step into the amazing world of C2C.
Hopefully this will lead to Cradle to Cradle ®, guided by MBDC and EPEA.

The website will be filled with new material all the time by ourselves and by our project partners.

Working and Learning in the World of Cradle to Cradle
Chapter 1: Why

September 2012

Why do we need to do something different?

Script: Dr. Sonja Eser, SinnenWandel

Involve – make it desirous to learn about Cradle to Cradle.
Answer of the question „Why".
Why change something?
Why is our current system not working anymore?
Why changing the existing framework (and how to get rid of the old things?)
What are solutions discussed at the moment?

Students are aware that the current economic system is not working anymore and why.
Students are aware that they are in a system which shows as behavior cradle-to-grave. They are aware that it is not personal guilt.
Students have discussed today's environmental business challenges.

Systemic vs. linear thinking.
Actual sustainable solutions discussed.
Business Challenges.

System Thinking – seeing the bigger picture.
Change Frameworks.

Question to students:

0.Advanced organizer/ your homework

"You saw the documentary Waste = Food as homework. What was your decisive moment in the film and explain why".

1. Involve

Teacher's Background Comment:
Cradle to Cradle is different from e.g. eco-design in the way that it doesn't start with the problem but with an intention and a vision.
This chapter also starts with a vision of our future. The students will later learn what the quotes listed here mean in detail.
Cradle to Cradle thinking is though weaved into the learning path this handbook tries to accompany you and your students through.

1.1 Creating our Future

„Leave life behind instead of death" William McDonough

Would you like to be beneficial as a tree?
Trees are beneficial. They absorb CO_2, produce oxygen, biomass, support biodiversity, provide habitat for many species, filter the air etc. We love trees, though they have an impact, a footprint. But no one would criticize this. Our ecological footprint[1] though is calculated to be far too big, that means we are using up our natural resources.

Everywhere we look in the world we see traces of destruction. There are so many problems we could be overwhelmed with.

Though we have a huge impact on natural systems, we humans are also part of the natural system.
Together with the beavers we are the only species that actively creates our environment. But it seems that we are using our creative powers only to exploit and destroy nature. Since the 1970s more and more people started to feel guilty and the idea came up: "it would be better if we weren't here". This is a depressing and pessimistic way to look in the world.

Be Beneficial

What about becoming beneficial like a tree? Having an impact, but a beneficial one!
What would you say of a way to produce things that does not destroy live but enriches it? A design of products and processes that loved all children, of all species, for all time? [2]
If we had factory premises that are safe for children to play on.
A world where there is no problem with mobility because the cars are designed as nutrievehicles - they release positive emissions[3].
If we would live in houses that are like trees, produce their own energy, clean their water and give living space also to other species.

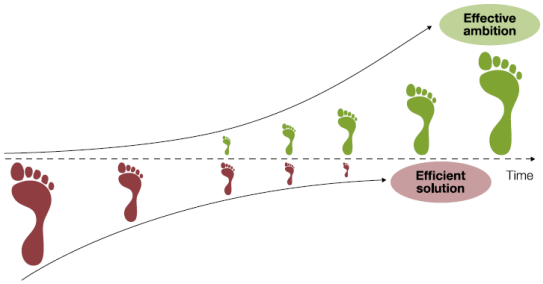
This sounds like a future vision? Yes it is. It is called Cradle to Cradle Design Philosophy.
"Our goal is a delightfully diverse, safe, healthy and just world, with clean air, water, soil and power – economically, equitably, ecologically and elegantly enjoyed." (Philosophy of C2C)

If you start learning about Cradle to Cradle, you will learn how three principles help us to produce products and invent processes that are beneficial. Products optimized with the Cradle to Cradle perspective and material flows cause no damage in the environment. The flow of materials is organized in cycles. That means instead of depleting our resources we only borrow them a while and give them back. To make our impact beneficial we must rebuild topsoil with humus from compostable products, recycle technical nutrients so that we do not have to mine for more, and in this way support the nutrient cycle of other organisms.
So with C2C we stop the exploitation of nature. Though we still have a footprint we start to have a positive one, like a tree.

[1] http://www.footprintnetwork.org/en/index.php/GFN/page/world_footprint/

[2] McDonough, Remaking the way we make things, p. 14.
[3] McDonough, Remaking the way we make things, p. 179

Source: *Royal Haskoning*



Discussion with students:
Wherefrom would you know that you are beneficial? Think about the products you buy, the manufacturing of your food etc. What would be different if we had a footprint like a tree?

Question to students for a group work:
How could a world look like you want to live in?

Question to Students:
How do you feel while you are hearing this?

Teacher's Background Comment:
The way we feel is influencing the way we think. If we feel guilty about the problems in the world, we cannot come up with creative solutions. Please observe in class if the feeling of students at some point turns into positive feeling. Then probably students have got the meaning of C2C - becoming native to the planet again.

1.2 Why change something?

We are talking here about a vision how we would like to live in the future. Why not leave everything like it is? As mentioned we face various serious environmental problems. They touch and change business in a serious way.

Big environmental issues that touch business today[4]:
1. Climate Change.
2. Scarcity of resources, renewables (deforestation, overfishing) and non-renewables (especially oil, rare-earth metals).
3. Toxic substances and heavy metals in products and environment.
4. Increasing world population (7 billion people in 2011); increasing demand in lifestyle.
5. Loss of biodiversity.
6. Water scarcity and pollution.

1.2.1 Climate Change

There is ample evidence today that we are having a climate change. High carbon dioxide emissions (CO2) have become a big concern. With emission limits and carbon trading governments are trying to stop the global warming.
Of course industry is a big player in releasing carbon emissions. Costs of carbon trading will be an issue in coming years.

1.2.2 Scarcity of Resources

Though we are discussing a lot about energy problems, the material problem is much more pressing. We are depleting our resources and face the prospect of running out of key resources like oil and rare-earth metals. We are heavily relying on our natural resources and use them up. E.g. industrial agriculture in lots of countries has caused heavy loss of fertile soil.
As energy has been very cheap in past decades, it was easy to throw things away. So the concept of "waste" emerged. It was more expensive to reuse the material than digging for new one.
We spread a lot of waste all over the planet. E.g. there are huge amounts of plastic circulating in the oceans. Birds and sea mammals feed on this, thinking they are catching nice fish and eventually die (see film Plastic Planet).
Especially high tech industry is facing rapidly rising prices for essential rare earth metals like indium or gallium, which are needed for solar panels, mobile phones, computers etc.

1.2.3 Toxic pollution

With the industrialization, toxic pollution started. Especially men designed substances that do not or very slowly degrade in the environment. Though there is a common believe about toxic substances: "the dose makes the

[4] Green to Gold, D. Esty and A.Winston

poison" (Paracelsus), today we realized that also long-term exposure to low doses could have effect on human health, e.g. this could create cancer.

Realizing this, the response was not to ban the substances that cause cancer, but to define threshold levels by testing on animals. Following this, industry was permitted to use hazardous substances as long as levels in the environment were not alarmingly high. With this policy, toxic substances have spread into every corner of the environment. Even our blood contains up to 212 different chemical substances. They are also transferred to children through breastfeeding.
Today customers more and more learn about protecting their health by avoiding specific products. Companies had to callback products (like children toys by Mantell). A loss of confidence in a brand can cause huge economic damage for this company.

1.2.4 Increasing world population

In 2011 we reached the mark of 7 billion people on this planet. The problem is not the number, but the way we are producing and consuming. Emerging markets like China and India are copying European and American lifestyle – and also the way of production.
These are big new markets but we also face the problem how to fulfill the needs of so many people on earth if we continue using up our resources.

1.2.5 Loss of biodiversity and extinction of species

Plants and animals today are threatened by the actions of us humans. They lose living space when we take resources out of the earth, build new commercial parks or streets. But animals are also threatened by toxic substances or climate change. So – why care? Because a lot of them are responsible to keep ecological systems in balance. *If we lose these species, ecosystems can collapse and with them the services they provide for us. Creating industrial ways for this is very expensive* [5]
Also a lot of new pharmaceuticals are from plants and animals in endangered regions like the tropical forest and we for sure lose possibilities to find cures for illness with the loss of these species. There are also different farm animals and useful plants which can cope with different climate conditions. This will become important for world food affairs with climate change. And last but not least species have value in themselves.

Exercise:
What do you think, where do you profit from biodiversity? Do you support it? Where are links?

Teacher's Background Comment:
e.g. fertility of soils and yielding a large crop, weather which is also influence by big forest areas like tropical rain forests or northern forests, fish richness in the oceans, pharmaceuticals from plants etc.

1.2.6 Water

Water is the essence of live. Only 1-2% of the earth water is fresh water. Growing population and economies are making substantial stress on water resources especially in drier regions. Coca Cola e.g. in India took so much water that surrounding farmers could not water their fields anymore. Also increasing pollution of water is a matter, e.g. a lot of textile industries in Asia release their production water into rivers without wastewater treatment.[6] Another example is the flower production in Kenya with release of high pesticide loads in local water reserves. *So business will get and are getting in conflict with other interests if they do not take better care of the water they use.*

1.3 How did we come here?

1.3.1. Short History about Quest for Resources

[5] See UN report "Global Biodiversity Outlook" GBO-3 http://gbo3.cbd.int.
Projekt Economics of Ecosystems and Biodiversity TEEB http://www.teebweb.org
[6] See Greenpeace Campaign „Detox"

Earth overshoot day 2012 was on August 22. That means that we are using our natural capital faster than it can replenish. That is like having expenses that continuously exceed income. E.g. climate change is the result of greenhouse gases being emitted faster than they can be absorbed by forests and oceans.
So what is the root of this behavior? It seems to be the quest for raw materials that is at least as old as the Roman Empire and Vikings raids.
With Columbus 1492 and continuing for nearly 350 years countries like Spain, France and Great Britain went for resources all over the globe. The Spanish empire e.g. organized a huge system to exploit the land, labor and mineral wealth of South America. Driving forces were mainly economical reasons but also strategic manoeuvres to gain more power.
Even over 300 years ago natural resources in Europe were overexploited like wood.
After an overuse of forests e.g. in middle Europe a lot of legislations came into being, regulating who, how much and how often and for what purpose wood was allowed to be harvested. 300 years ago forestry was founded in Germany together with the term "sustainability". In forestry context this means not to harvest more wood than grows again.

In the last century population on earth exploded. Overrun by industrial colonization hundreds of indigenous people were forced to the western way of live. At the same time advertising made American Way of Live desirous.
Today only few folks live in harmony with nature. Rising consumption in countries like China and India will rapidly sharpen today's situation.

It is high time to change something.

1.3.2. Linear/mechanistic Thinking vs. Systemic Thinking

What is the behavior of our current system?

We have come to rules and procedures that produce waste, overuse resources and exploits working labor.

It starts with the way we see the world. We call this a "paradigm".
At the moment we see and behave like nature is an unlimited resource (and waste bin).
The result: our economy has become a waste producing system. There are only some useful products on the way. Most of the things are thrown away in a very short time. (See video Story of Stuff).

This we call **Cradle to Grave Paradigm:** we extract resources, shape them into products, sell them and throw products away in some kind of "grave", usually a landfill or incineration. This is a linear way of thinking.

As long as we accept the concept of waste, the economic system will stay the same.

1.3.3. Mind set/Frame of thinking of the Occident

There are four pillars for the way we see the world in Europe[7]. (Please mind that e.g. Asian thinking is much more acquainted with circular and systemic views).
Aristotle: either-or-logic
Galileo: Measure everything.
Descartes: Analyze and fragment everything.
Newton: find a cause for everything (cause and effect)

The way we think and see the world was coined by the logic of Aristotle.
We still follow rules in thinking, especially the either-or-logic. Situations with contradictions can thus become very difficult.

A substantial share of our way to think comes from Descartes. "Cogito ergo sum". This was also the start of mechanistic thinking, of the world functioning as a machine which can be separated into smallest parts and only understood this way.

[7] Herbert Pietschmann, BodenLeben Symposium München 27.7.2012, „Die Atomisierung der Gesellschaft"

Lots of management literature today still writes in the way that organizations can be managed when pulling leverages etc.

Newton explained the laws of nature from his perspective as physicist. His words came from the mechanic of balls. So we still use a lot of this words today, e.g. it was on the news that Barack Obama had a "backlash" (like a ball from a wall), we have to pull levers (like in a machine), something has an "impact" (like a heavy object falls down).

1.3.4. Age of Quantum Physics and Systemic Worldviews

How does a system work?

A system works according to its rules.
If you play a game according to the rules of this game, you will always end up with nearly the same behavior in the game. Remember "Monopoly"? Everyone wants to have the hotels on Park lane. So what about sustainable behavior in Monopoly? Well, unless you change the rules, it will not work out. You will lose. The system of the game is not set up to give good results with this interaction.
A lot of people at the moment may have that feeling while going green. They are inspired to "save the earth", are working in environmental protection e.g. Greenpeace etc. Though their work is of high importance, the rules of our economic system are not changed, they stay the same.

Do you actually realize that we are in a system?

So what is a system?

Systems are e.g. a living organism, an eco-system but also a company with all its employees, structures and interactions. A system consists of different elements that interact with each other. The structure of the system enables it to fulfill particular functions. If the integrity of the system is disturbed, it cannot fulfill these functions anymore. You cannot split a system
Example:

A company is a system, a waste deposit not, it consists of a lot of elements but they are not interacting with each other.
A rainforest in Southern America is a very fragile ecosystem. Most of the nutrients are stored in the biomass of plants and animals. If you cut down the trees, you lose most of the nutrients. The soil is very old and there is not much left for plant roots to feed on. There will be another system like a savannah but the system forest cannot thrive here anymore.

What does systemic thinking change?

Ecosystem researchers have found that there are lots of interactions in a system. There are not cause-effect-behaviors but various ways to behave. Quantum Physics has shown that a thing can be as well a particle as a wave.

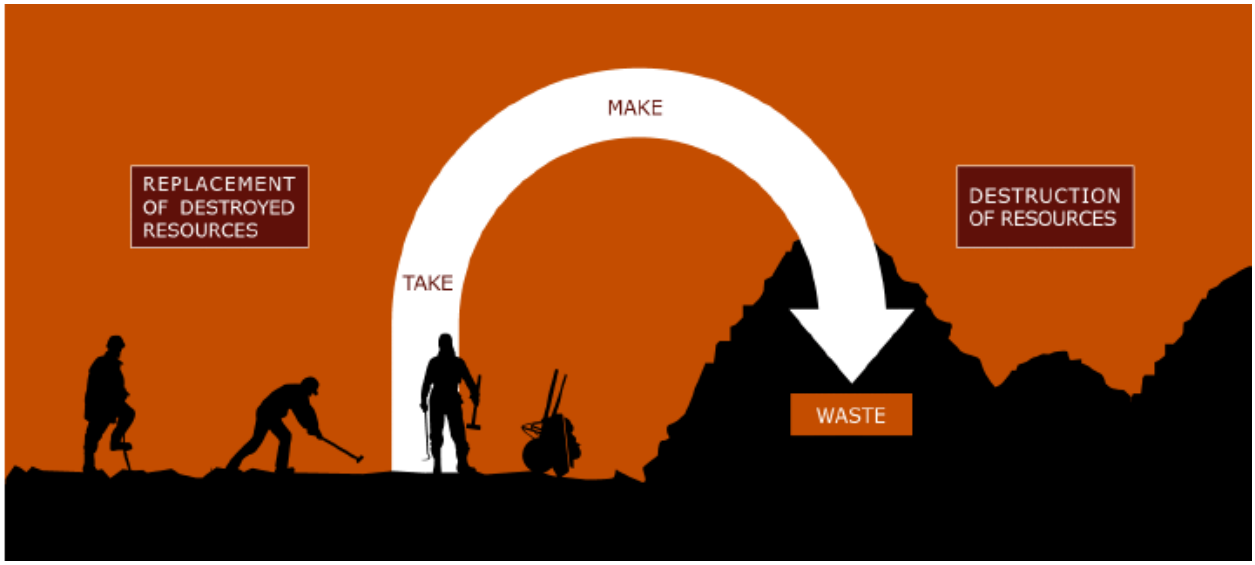
When we try on the systemic lens, we can see the interconnections between men and biodiversity. We can understand feedback loops and the dynamics of exponential growth. We can see that we are dependent on good working living systems and cannot fix everything. We can anticipate that toxics we release into the environment find their way back to our food chain. We can understand the act of piracy at the coasts of Somalia as an effect of very low fish populations and hunger.

We can understand the dynamic of tipping points in climate change (small changes can cause big effects) and can accept scenarios and probability calculations as no one can exactly make a forecast of the behavior of a system.

If you use the lens of this framework you understand that our common sustainable understanding at the moment with "use less, waste less and recycle" is focusing on individual responsibility and try to make things a little better. We are "shopping to protect ourselves" (Source: S&S Ken Webster).
While blaming the single person for greed we still stick in our linear thinking and perception of the world.

To change something we first have to be aware that we need to see the whole story and start thinking in systems.
We have turned to guild management and try to change our own behavior in the first place. Though this is also important, we have to demand change of politicians and institutions - this would cause a systemic change.

With this lens we will also see that we have to change rules of the game if we want to have another behavior (e.g. circular economy, no waste).



Picture EPEA GmbH

1.4 Which way out? Sustainable ideas

Question to students:
"If we continue with Cradle to Grave, where do you think our current system will lead us?" Discuss.

Some answers:
- Plastic in Ocean whirls, waste on beaches
- Bad social standards in Production
- Scarce Resources
- Toxics in Children's toys
- The time component – we cannot go on forever spending resources.

So what are solutions?

We know today perfectly how we should not proceed and what we do not want anymore. But how solve these problems? How to implement new strategies into business?

1.4.1. Fewer People

Are we too many? Well, if we put all ants on the world on a scale and all humans, the biomass of ants is 4 times more than that of humans. All of them eat, work, and build their social states. But they are not causing problems, indeed, ants are considered to be especially beneficial for forests.

So we are not too many, we are just behaving foolishly. (See box ants)

1.4.2. More Efficiency

We have undertaken a lot of efforts to use less material and energy. Most technical innovations today have the goal of more efficiency. It means to make more with less. For sure it reduces economic costs as it reduces the input of material or energy. It also reduces environmental destruction.
But: this is an idea of being less bad.

Reduction only slows down the process of destruction and resource depletion. It does not change the structure of the system.
And what is more, while we e.g. try to reduce the carbon emission of a single car, the number of automobiles worldwide increases. So what we save at one car is overcompensated with increasing consume. This is called Rebound Effects (see box)

1.4.3. Reduce, Reuse, Recycle, or called the waste hierarchy.

Reduce = Use less stuff
Reuse = Use stuff again
Recycle = make old stuff into new stuff

Reduce - Use less

Will it be enough if we just change our life style? If we buy less, use less? It seems to be a promising solution, and "everybody can make a change". You probably have heard that it is your personal responsibility to reduce waste, buy less. We should reduce our ecological footprint (see Resource Footprint Network).
But what about the growing world population? And their demand for more products? What about our GPI? Every politician is talking about growth of economy. If we all stop consuming, what then?
Though it seems a good way to use less, it does not alter the way of destruction, it just slows it down. An important goal is to reduce the amount of toxic substances in the environment. Though the direction is right, even small amounts of harmful substances can have big effects on health and ecosystems.

So this is an idea like "Making the situation a little less bad." But this reduction will not change the system. It will still be a system of Take-Make-Waste.

Reuse is quite a common concept, e.g. with eBay or second-hand books at Amazon. It seems a nice idea also to reuse waste like old tires in children's swings or even make kitchen bowls out of it. But with this strategy we only transfer the harmful substances and waste to other places. Unless materials are safe, reuse can cause more damage.

Recycling:

Recycling of material for sure is a good idea. But we seldom do re-cycling today. Most things are down-cycled which means that the quality of the material is reduced over time. Often different materials like plastics are mixed to produce a material of lower quality. Colors and coatings in metals also lower quality of recycled product. So think about all the colors, softening agent, additives in a product. A lot of them cause problems in the recycling process. The products are not designed for recycling. But we can only talk about re-cycling, when the material has the same quality as the virgin material.

1.5. What about Re-Think and Re-Design - the Cradle to Cradle Way

How about designing our future? To really intent what we are doing, that means to really make products for recycling and parts in products for reusing them. In usual waste hierarchies this is not an option at all.

We understand design here as comprehensive rethinking, reinventing of a product or service, not only as styling and make-up.

If we state our intention to design a different future, a future without waste, then we have to rethink what we are producing. It is about doing the right things, not only doing things right.

If we do not accept, that while we promote economic growth we destroy at the same time our livelihood, than we have to redesign what we are doing. Especially we have to redesign the production processes with which we are working from Cradle to Grave to Cradle to Cradle to make it possible for materials to be kept in cycles.

If we see nature only as an exploitable source for resources we will stick to take-make-waste. If we start to see nature as a teacher, showing us ways to keep material flowing in endlessly intermingled cycles than we can transfer to a Cradle to Cradle way. This seems to us, the authors, the more intelligent way out.

Necessary for this is also to see the whole picture and start with system thinking.

For detailed information on economic benefits from a circular economy please see reports "Towards a Circular Economy" and "Resilience in the Round".

Economic Benefits

Example:
Beverage tins are made of aluminum. As return rate is not 100%, we are losing about 30% of aluminum with every recycling step. Calculate when you have lost half of the material by weight. (Half-life Calculation).

Here's the essential break between light green and bright green thinking: the reality is that the changes we must make are systemic changes.
Alex Steffen

Example Ants

Ants have more biomass than we have, but they are no problem to the planet, the climate, the soil or the oceans. In fact, ants are considered very helpful animals in the forests. They benefit the soil.
Why? They keep to the rules, that means they keep material in cycles.

What are we doing instead? For example we take so much from the agricultural land that soil fertility decreases. We do not give back (unless we are doing organic farming). We cut down too many trees so they cannot recover, and forests turn into deserts/grassland.
And we invented **waste**. Waste is a new concept to nature, as all things produced by other organisms can be broken down and reused. The waste we are making cannot be used again. In fact, it makes a lot of trouble all over the place.
(See e.g. film Plastic Planet, plastic is weathered into smaller pieces and spread all over the place. Or heavy metals are everywhere in our food chain. No human breast milk is ready for selling in a supermarket if someone would like to.) (Resource: Video EMF)

Time Table for Chapter 1

Total Time: 1h 30min up to 2h 30min

Time (minutes)	Steps	Description/ Background	Material
5‘-15‘	**Involve: Creating our future**	Question to students: How could a world look like you want to live in?	Video Waste= Food as homework
10‘	**Why change something?**		Slides of Chapter 1, Big Environmental Issues
15’-45’	**Film parts: e.g. Plastic Planet, Story of Stuff**		
15’	**How did we come here?** **Cradle-to-Grave Paradigm**	Input about Quest for Resources, Linear Thinking	
10’	**Activity: Do you know that we are in a system?** **Show emergent properties/behavior of system rules**	Input: mechanical thinking vs. system thinking Activity: “Flying Hoop”	Hoop
10’	**Reflect on activity: if system conditions are wrong, you cannot win without changing the system structure**	Show: Consequences of linear approach	
10’-20’	**Which way out?**	Input: Different possibilities	Videos from EMF, typical answers of where to go now
5’	**Activity: Calculation of Material losses, Example aluminium tins**		
	Rethink and Redesign: Cradle to Cradle way	Input: new framework	
10’	**Activity: What has this all to do with business?**	Discussion: why is this relevant for businesses? Group work: “How is business affected through the environmental issues today?”	

Material needed/available for this Module

Slides Chapter 1	
Video Series from EMF	
Video of Ken Webster on YouTube	
Description “Flying Hoop”	
Documentary Waste = Food	http:documentaryheaven.com/waste-food/
Project Website	www.duurzaammbo.nl
Valuable Cradle to Cradle related videos	On the project website
Film Plastic planet	German version: http://www.youtube.com/watch?v=TKI3h5vy8Wk English Version: http://www.youtube.com/watch?v=tMCkir9PSpw

Literature

William McDonough & Michael Braungart (2002): Cradle to Cradle. Remaking the way we make things.
Ken Webster & Craig Johnson (2010): Sense and Sustainability. Educating for a circular economy.
Janine Benyus, Biomimicry (for more nature principles) http://biomimicry.net/

Working and Learning in the World of Cradle to Cradle
Chapter 2: What

September 2012

What is Cradle to Cradle?

Script: Dr. Sonja Eser, SinnenWandel

0.1 Frame

What is Cradle to Cradle?

0.2 Goals

Students have understood that Cradle to Cradle is a modern, circular solution to end the concept of waste and improve the quality of processes for better water stewardship, social standards and use of renewable energy.

Students have learned the three basic principles of Cradle to Cradle.

Students have understood that it is important to see the bigger picture to bring Cradle to Cradle to work.

0.3 Knowledge Transfer

Learn lessons from nature: understand nature´s principles and how to use it in industrial systems.

Rethink the three basic principles of Cradle to Cradle.

Mindset of Cradle to Cradle – what is different in the thinking about C2C than thinking about being more efficient.

Use and learn new vocabulary (nutrient, metabolism, be beneficial, waste equals food, eco-effectiveness).

Understand the problems in products at the moment – raise awareness.

0.4 Key Words

Eco-Effectiveness.

Nutrients.

Biological and Technical Metabolism.

Current Solar Income.

0.5 Skills

Become creative, start creating the future.

Ask different questions (reframe questions into powerful questions, “Imagineering”).

Chapter 2 „What“

2. Cradle to Cradle

What kind of detergence would the river like? How can we produce it so that it will support aquatic life?[8]
What about an ice-cream cone that is only solid while frozen and melts when you throw it away and waters the seeds that are packed inside?

These are new questions to industrial design. These are Cradle to Cradle questions.
Cradle to Cradle is a design-concept guided by nature. It is an innovation framework. It is also a philosophy. It is about a third industrial revolution.
It is about “Remaking the way we make things”. This means to rethink products, processes, systems. And eventually remake them.
.
Cradle to Cradle creates a transition from the current industrial model to a system with healthy and safe products, whose materials stay in cycles.
C2C enables the creation of wholly beneficial industrial systems. This concept does not only apply to products or processes but also to industry business models, services, urban and regional planning and architecture.

The special thing about Cradle to Cradle

It gives hope. Instead of the sentence: “it would be best we weren’t here” it changes depressive future perspectives into the will to be creative and help to build the future. How comes?
Since the 70s environmental protection became more important and we were drilled into the mindset of personal guilt. A lot of young people did not want to have babies in a world which looked so devastated.
If we are scared, our brain leaves us only three ways to react: fight, run or feign death. There is only a very small path to stay capable of acting. And this path we can only reach if there is hope and if we can be creative. This is the biggest power that evolution has given to us. The idea of a positive footprint, about being beneficial and becoming native to our planet gives people the possibility to use their creative powers to build a positive future.

2.1 What Cradle to Cradle is not

Cradle to Cradle is not equal to the term “sustainability”. These are two different concepts. They both have the vision of a better world. But the ways to achieve this are quite different.

Sustainability today is often discussed in the light of efficiency and personal responsibility. This may lead to problems discussed in chapter 1. The aim is to minimize the environmental damage – calculated as ecological footprint. This is an idea of making the things “less bad.”

2.2 What is Cradle to Cradle

Cradle to Cradle instead is the idea of “doing the right things right first time”.
In a world discussing limits and minimizing, it sees a world of abundance. If we would design our production systems properly, our big impact could be beneficial instead of devastating (= positive footprint). This means that we set up cycling material flows, where each material at the end of the product use is used as nutrient for new products.
Where sustainability tries to minimize the impact of human activities, Cradle to Cradle starts by designing product and processes for environmental purposes.

While sustainability issues are often discussed as additional costs, Cradle to Cradle tries to enhance economic benefits via triggering innovations. It is an economic concept, looking for new business opportunities while integrating an environmental friendly way of producing into the strategy of a company. It adds value for the customer as well as for the manufacturer (enhancing product quality).
With this concept, companies have started making products with surplus value: that improve the quality of life.

Cradle to Cradle actively supports species, e.g. with compostable products that help to rebuild top-soil, or by sending products with toxic substances back into technical metabolisms so they are not released into soils and rivers.

The Cradle to Cradle® design concept is an idea of the German chemist Prof. Dr. Michael Braungart and the American architect William McDonough. Its basis is the Intelligent Product System (IPS) that Braungart’s company EPEA (Environmental Protection and Encouragement Agency) developed from 1987 to 1992. Currently, hundreds of enterprises around the world offer products designed after the Cradle to Cradle® design concept – among them many are from the Netherlands, the United States of America, Taiwan, Denmark, Austria, Switzerland and Germany. Even local authorities or institutions use it in their procurement.

[8] McDonough, Remaking the way we make things, p. 145.

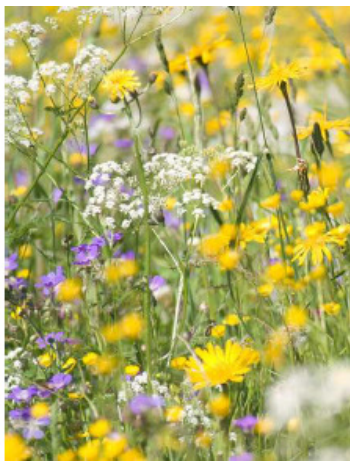
2.3 Learning from Nature

Ecosystems are functioning now for over 3.7 billion years. Learning from these successful systems is helpful to create economic systems that work in harmony with nature.

1. There is no waste. Material is constantly transformed from one organism to another. Material – and with it stored energy in the molecules is passed over cascades until decomposer like mushrooms and bacteria's in the soil break down the last digestible molecules (biogeochemical cycles of materials). Live necessarily relies on recycling of the limited chemical elements.

2. Organisms use current solar income.
The sun is an eternal energy source. Though plants use only 1-2% of solar radiation in photosynthesis, this is sufficient to support an awesome mass of organisms relying on phyto-biomass to feed on (about 170 billion tons organic substance).

3. Diversity is a characteristic trait of live. Over 1.5 Mio species were discovered until now. The resilience of ecosystems relies on diversity of species.



2.4 Three basic principles

The Cradle to Cradle concept applies principles that we observe in nature to our industrial systems.

At the moment we do not take care enough of the natural processes our economic system is embedded into.
With Cradle to Cradle we change the framework of "Nature as unlimited resource" to "Nature as teacher and Partner"

Cradle to Cradle Basic Principles
Waste = Food
Use current solar income
Celebrate Diversity

These design principles are helping us to find innovative product solutions using the three guiding principles of C2C.

2.4.1. Waste equals food.

To get rid of the concept of waste, we have to start to bring material in cycles.
If we look at a cherry tree we see that a lot of blossoms or fruits fall down to earth. No one would complain about the tree littering the environment, as all these materials decompose and are broken down into nutrients.
So if we want to do it like the cherry tree, we have to design materials out of renewable sources for the biological metabolism:

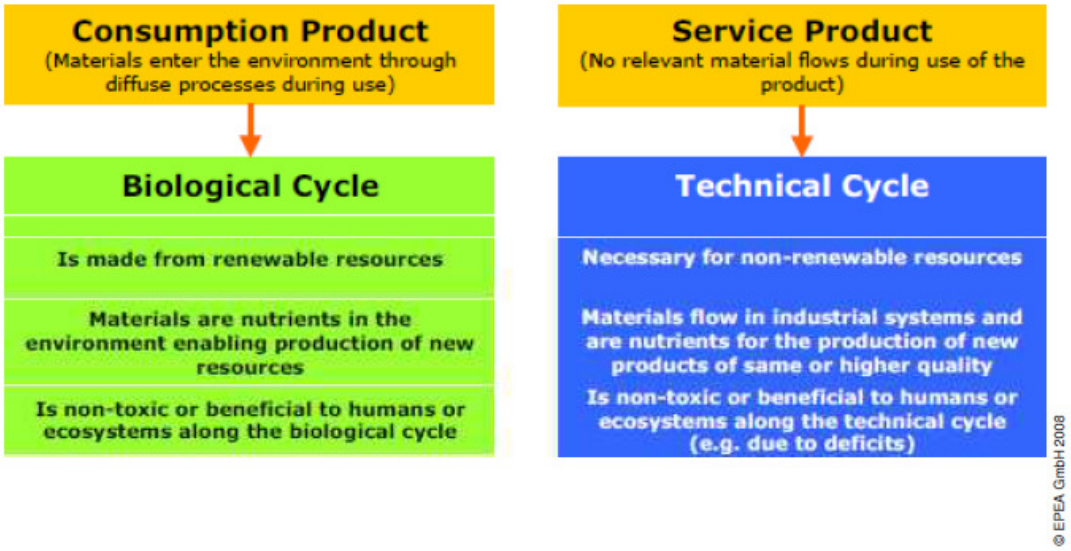
The **biological cycle** is for all products from renewable resources products like wood, maize, and cotton. Products designed for this metabolism are biodegradable and can safely be returned to soil for biological processes. Biological nutrients are ideal for consumption products, i.e. products that enter the environment through diffuse processes during use. Products are: detergents, cosmetics, textiles etc. but also shoe soles and brake pads which are used up.

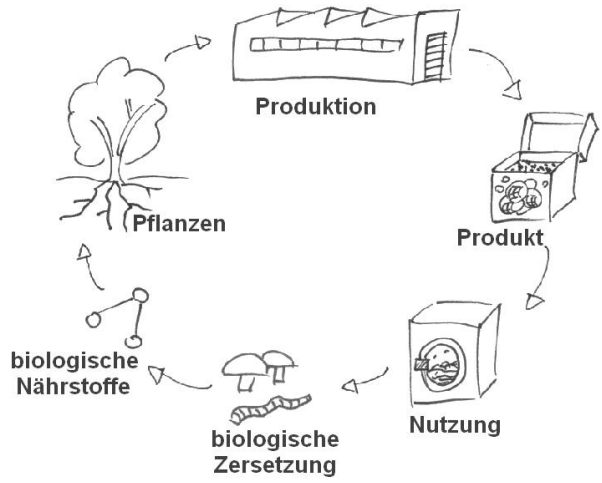
Reminder: Everything that ends in the environment should be designed for the biological metabolism. Also natural minerals like calcium carbonate or clay could be safely used in this metabolism.

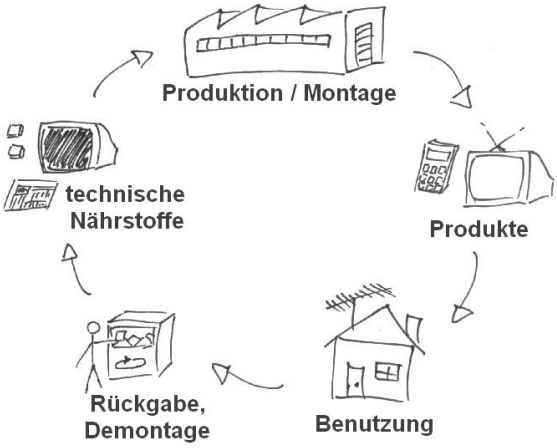
But for sure we cannot decompose a computer. So for this we need a second cycle.
Products designed for the **technical metabolism** are made out of non-renewable resources. A technical nutrient is material that can be safely reused in a continuous industrial cycle, in a closed-loop system of manufacture, use, recovery and reuse.
Products must be designed in a way that material will maintain the quality or even is upgraded while cycling. Harmful substances that we cannot substitute have to be kept closely in this cycle, so that they do no harm.
Products are: computers, cars, bicycle, mobile phones, furniture etc.
These products are suitable as service products. They can be rent or leased to customers, so that the manufacturer remains the owner of the material.

Reminder: also products from renewable resources can be kept in technical cycles for a while, e.g. PLA bioplastic can be recycled perfectly. It would be not reasonable to send it to compost after one use.

Products according to Cradle to Cradle should be designed as either biological or technical nutrient or if both in a way that material can easily be separated. Products should be designed to be a nutrient of something else (the next cradle). In that way products are beneficial and useful like material in nature.







Biological and technical metabolism (EPEA GmbH)

Exercise: Analyze the environmental fate of materials of your favorite product. Where does it go if we do take care of the material flow and if we don't take care of it? (E.g. Internet link Source map)

Exercise: Look at material flow through your school and home. What material gets stuck with you? Can you do something so that it can continue as material for other products?

2.4.2. Use current solar income:

The climate change is due to our use of historic solar income in form of oil or gas. Using current solar income includes wind power, solar thermal energy, photovoltaic electricity production, and the use of biomass.
It is absolutely necessary to shift to renewable energy but we should be careful not to contradict the third principle (celebrate diversity) while using for example biomass.
Example: with biodiesel we try to reduce the use of oil. Biodiesel is produced from soybeans or palm-oil. Both plants are grown in areas, where former tropical forests were cut down to make place for plantations of oil palms and fields of soybeans. This for sure decreases biodiversity. Better solutions take biomass from organic waste, residuals from food plants or other leftovers.

Other regenerative energy forms could also come from tidal power as well as difference between salt- and freshwater or geothermal warmth.

2.4.3 Celebrate diversity:

Healthy ecosystems are complex networks of living organisms.
Our impact in various ways is especially destroying living space for animals and plants. We are losing 100 (!) species a day. To learn from nature means to celebrate diversity in the way to support biodiversity.
Example: Thomas Rau, an architect in The Netherlands, has build nesting aids for birds and holes for bats in a building he has refurbished.
But we also have to be aware to celebrate our cultural or conceptual diversity.

2.4.4 New Vocabulary

In Cradle to Cradle we use different vocabulary. This is important because it evokes in an unconscious way new thinking.

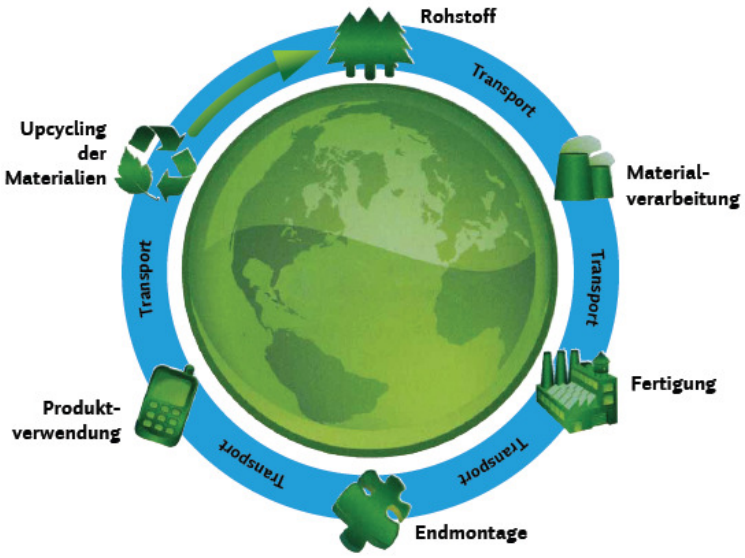
New Vocabulary:
Nutrient: instead of speaking about virgin materials and waste, we use here the term: Nutrient. This helps to think in circular systems.
Metabolism: like in nature we speak of material flows in metabolisms. You can also use the word cycle.
Service product: Manufacturer remains owner of material, the consumer pays for the design, use, and maintenance.
Consumption product: products that enter the environment through diffuse processes during use (wash away, textiles pill off)
Waste = Food: food we eat, it nourishes us. In the same way we use nutrients in C2C to nourish new products.

2.5 Eco-Effectiveness

With the Cradle to Cradle concept we follow the idea of eco-effectiveness.
If we look at a cherry tree, we find that it is not efficient. There are thousands of blossoms at it in spring and hundreds of cherries in summer. But nothing gets lost; everything is nutrient for other organisms. All material is recovered, recycled and flows from one organism to another.

Eco-effectiveness means to implement this principle to our industrial systems and design products as a nutrient. All material should flow either in a biological or a technical cycle.

Discussion in class: what can you imagine our future to look like in a Cradle to Cradle way? Or make a reporter game out of this; ask your classmates or people on the street.



Quelle FullCircleDesign

Teacher's Background Comment:
See product examples and case studies how these three principles help to design and produce different products.

See Almere Principles how to use C2C principles for regional development. See Floriade Guidelines for using C2C principles for a big event.

2.6 Bring C2C into work

2.6.1 Five areas of interest

When we want to make a Cradle to Cradle product, we have to look at five areas to improve:

1. Material health –for safe and healthy ingredients and materials
(This involves ABC-X Categorization and defining for biological or technical cycle).

2. Re-utilization of materials (are materials recyclable/compostable and is a reverse logistic in place?)

3. Use of renewable energy (does production process use energy from renewable sources?)

4. Water Stewardship – it is important to carefully treat water resources in production.

5. Social responsibility – companies need to adopt social and ethical performance goals for fair labor practices e.g. no child labor, no forced labor, freedom of association for workers, no discrimination[9].

2.6.2 Economic benefits (C2C in a nutshell for CEOs etc.)[10][11]

There are many potential business opportunities waiting by going circular.

Competitive advantage of organizations especially in Europe suffers from high price volatility of resources in the past years. Linear system of Take-Make-Waste increases exposure to higher resource prices and supply disruptions, a strategic risk for companies.[12]
C2C design: Recovery of resources reduces the material bill and expenses of disposal and is the basis to be more independent of the world market with wars, crises, export boycotts.
Most of the value will come from remanufacture, refurbishing and reselling of goods. Recycling is last in line. Optimized processes also save materials and energy.

A company has to be innovative to be successful.

C2C design: is an innovation platform. While integrating in the strategy of the company, it increases innovation in the organization, a prerequisite to be competitive.

While focusing on the total system performance rather on a single component, innovative power in a company increases.

Legislations about the use of toxic substances have become stricter.

C2C design: Risks are known and minimized, Risk prevention for the company as the product is safe for environment and health (no potential claims for damages)

With carbon trading emission quantities have got a price.

C2C design: CO_2 is treated as nutrient, ways to bring CO_2 back into cycles and rebuild soil.

There is also more pressure from environmental protection groups to protect biodiversity.

C2C design: helps to be clear about the whole lifecycle of a product and the possibilities to support biodiversity

The way customer think has changed. The amount of people who are concerned especially about environmental issues has increased. Businesses are confronted with growing demand for sustainable products and services. E.g. "LOHAS" (a customer model called lifestyle of health and sustainability are buying products which are produced in a sustainable and ethical correct way. This market is increasing every day. But also in B2B markets there has been a rapid rise in sustainability requirements.

C2C design: strengthens the brand.

Better reputation, more customers, increases customer loyalty.

Employees love to work for these companies.

Customer Relationships are important for companies but marketing and communication is difficult in a saturated market.

C2C design: "C2C sells" is the "Tenor" of the report: C2C pays off! Marketing C2C can be a next step in CSR policy. Certification but especially the C2C story behind the products supports sales. C2C product also automatically generates free publicity. E.g. Van Houtum first compostable toilet paper made the company an "environmental hero". Sales increased over 50%.

New business models and customer bonds can be achieved from the concept of leasing instead of selling the product. As long as the customer is using the product, the bond between producer and customer will persist. For product developers and marketers there is much information in this.

Investors have started to favor companies who have sustainable goals.

A lot of studies have come to the result that sustainability gives companies not only competitive advantage, promote innovations but also makes an organization more robust and resilient to changing conditions.

And for sure a lot of CEOs and companies have understood the urgency of a shift in the "throw-away economy".

[9] Cradle to Cradle Certification Outlines, MBDC
[10] C2C pays off!
[11] Towards a circular economy
[12] Resilience in the Round

"The shift to a circular economy will lead to increased growth, jobs and resilience".
"Circular Economy means an industrial economy that is restorative and eliminates waste… Material flows are of two types: biological… and technical nutrients." [5]

2.6.3 Enablers and "wheels" that will push continuous material metabolism

Design and innovation: this is the pre-requisite to re-design and re-invent products for continuous metabolism, that are designed for remarketing, refurbishing, repair and disassembly, also for material cascading; about 80% of a product's environmental impact is "locked in" at the design stage [5].
New business models and savings: product performance will be more important in the future than ownership. Leasing instead of selling will be an important step. Customer bonds will last longer. Savings from return of material will be strategic.
Customer decisions: increasing awareness of customers will shift market shares.
Product collection and reuse: Infrastructure to collect products after use (reverse logistic) is a prerequisite for a circular economy. And hopefully this will be carbon neutral in the future. There are a lot of new job opportunities in material management, e.g. recycling companies like Van Gansewinkel has renamed itself to a "nutrient management company".
System changes: like revision of regulatory and fiscal framework will be necessary. E.g. cutting taxes on renewables including labour and move it to energy and materials (non-renewables).
Cooperation: between companies especially subcontractors and recycling companies.

2.6.4 Design is crucial

„Design is the first signal of human intention and that our urgent design brief is to design for nine billion people on a thriving planet. "
William McDonough

Designers have a big impact on the ecological quality of a product. Often they do not know this; they are hired to pimp up the look of a product. But they could also decide about material, manufacturing processes, use and afterlife of a product. Or they can even make a service out of a sales product. Cradle to Cradle is a design strategy. It intervenes where products and processes can really be changed – at the design stage. Ingredients and the expected environmental impact of a product are defined at this point.

Strategy: designing products and industrial processes that turn materials into nutrients by enabling their perpetual flow within one of two distinct metabolism: biological or technical.

Ideas matter
While sustainability teaches us to prevent damage, to reduce environmental impact, in Cradle to Cradle we try to be creative in design. Ideas are important.

So we start with values and principles like: "design a product/building that loves all the children of all species for all time", "design with material and energy flows that support both natural systems and business goals", "produce with a positive impact on the surrounding environment and local communities". In architecture we look for ideas to build "houses like trees, cities like forests".[13] This means buildings that, like trees produce more energy than they consume, purify their own waste water and release it slowly in a purer form.
Ford has rebuilt its premises with the idea: "let's make it safe for children to play on".

Discuss: What are good ideas your class comes up with?
If you could redesign your school/university/ company, what vision would you chose.

[13] Cradle to Cradle Criteria fort he build environemnt; Douglas Mulhall & Michael Braungart, 2010

2.6.5 Design for Disassembly

= design products so that each part can easily be separated from each other. The goal is to replace fixed connections with reversible ones.

2.6.6 Recycling instead of downcycling

In the attempt to get less waste, recycling was established in countries like Germany in the 70s. Though Germans are world champion in waste separation, a lot of recycling processes lead to quality losses in the technological capabilities of the material. Why? Usually products are not designed for a proper recycling process. E.g. the material composition is often a company secret of the manufacturer. So recycling processes are not suitable for a lot of products, and vice versa products are not suitable for recycling.
The consequence: material loses its quality. This is no re-cycling, but a down-cycling. The time until the material ends up in incineration is only delayed.

Real Recycling
Nature knows no downcycling. Material is continually provided in the same starting quality. This is the goal if we want to have good re-cycling. Or better even to improve the quality = up cycling (see 2.6.9.).

2.6.7 Defined use period

How long should a product last? When discussing this question under a sustainable view, people answer: as long as possible. But when we discuss it under a Cradle to Cradle view, this looks different. Cradle to Cradle products are designed to circulate and are nutrients for other products. So it is also reasonable, that material returns to the circle in a defined period. A lot of products today are old-fashioned in a short period of time – think about computers, mobile phones or clothes. This is due to development in technique, but also changes in lifestyles or taste. A mobile phone that would last for 10 years does not make sense. So it is reasonable to think of a defined use period instead. For example a company could rent instead of sell a computer. They could give an update each year to the customer, and after 3 years the computer returns to the manufacturer. This has also the advantage that the company knows when the material returns.

2.6.8 Material flow management

To set up metabolism also needs to think about material flows. The goal: achieving cyclical material flow that enables materials to maintain their status as nutrients, material quality and productivity over time or even for one company to get its own material back. But this is not necessary.

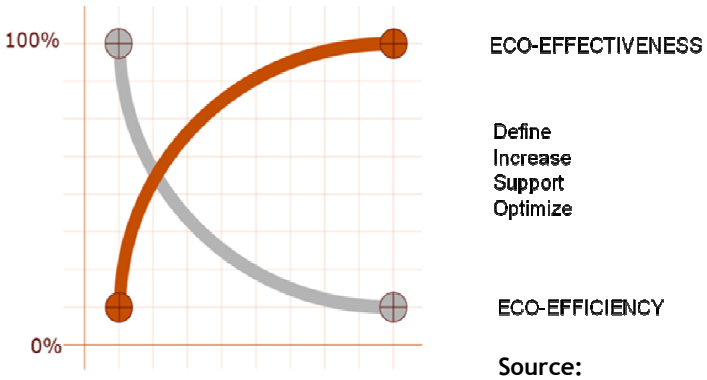
There are several intelligent Take Back Systems already in place:

- Reverse Logistic – one company takes back its own material for recycling (e.g. Desso provides even own recycling facility for its carpets).
- Leasing – the producer remains the owner of the material.
- Service – the customer only pays for the service, the manufacturer stays owner of the material. At the end of a defined use period material is picked up at the customer.
- Campaign days: the customer exchanges old product for a new one with discount.
- The usual recycling methods by recycling companies which separate defined materials and resell them as secondary raw materials.
- New recycling processes to start new material flows (like I:CO for clothes and shoes).

Maersk, a big container ship producer, has made Cradle to Cradle passports so that the company knows exactly what material has been built in where. After the use of the vessel, they can reuse all the material (see film Maersk).

Intelligent Materials Pooling (IMS)

Nature does not close the loops, that mean the material is not used again by the same individual. So it is also reasonable that different companies together form a network, where they use material together, even do research together. This strategic alliance also allows for better purchasing conditions and more market power.
Examples of networks in development: EcoCircle: Company Tejin/Japan has built a network with over 130 companies to recycle polyester fibers from clothes and drinking bottles.
PV Cycle: over 85% of the European photovoltaic market has joined this network to do research on recycling and reusing the materials of photovoltaic cells.



Source:
EPEA GmbH

2.6.9 Quality

The goal of C2C implementation is enhanced intrinsic quality. Product and processes should improve the quality of life.

So a high quality product has:

- Defined ingredients (see ABC-X).
- Material designed as nutrient.
- The product is safe for our health and environment, during and after use as well as degradation products.
- Defined use period.
- Products can easy be disassembled and can be separated by components (design for recycling).
- Concept of nutrient recovery in place.

2.6.10 ABC-X Categorization of materials

For improving the intrinsic quality of the products, every ingredient is categorized in a so called ABC-X categorization. Like traffic light system, green ingredients are recommended, red ones should be optimized.

The categorization takes into consideration human health criteria, environmental criteria's and the usability of the ingredient into cycles.

2.6.11 Positive or Preferred List – a tool

Usually we define critical limits for hazardous substances. Or we define which substances we should leave out. The positive list used in Cradle to Cradle give us the opportunity to decide which substance we want to use in a product. The Positive List contains substances that were categorized as yellow (B) or green (A) which are defined actively healthy or harmless in a specific scenario.

2.7 Peak P – history of a scarce resource

Peak P means the depletion of phosphate as fertilizer for agriculture, but also as a raw material for various industrial processes. Phosphate is an essential nutrient for all live, it cannot be supplemented.
Humans have to take up 2g phosphate with their food, but also excrete 2g a day.
Since the industrialization of agriculture, phosphate was mined and used to supplement for the harvest of organic substance from the fields. In former times, the excrements of people and animals were reused on the fields, so the phosphate cycle was closed. Today in highly industrialized countries, toxic substances in waste water make this procedure problematic. Sewage sludge is burned in incineration. (Remark: countries which still can use their sewage sludge to fertilize fields do not have these problems).

The natural resources of phosphate are getting scarce. Experts calculate that stocks will only last for about 20 years[14].

Different countries have now started programs to recycle phosphate from sludge or municipal waste water. There is also another possibility to bring organic fertilizer back into the ground – rebuilding soil with biological nutrients, see 2.8.1.

2.8.1 Compostable products against Climate Change

We lose 5-7 Mio. ha of fertile soil in one year. Erosion by Industrial agriculture and new buildings are the main causes. This is a huge loss of a natural capital. Rebuilding 1 cm of fertile soil layer takes up to 300 years.

Land degradation endangers agricultural production and food security. With humus in topsoil we also lose water retention, soil fertility and CO_2 into the atmosphere.
CO_2 is stored as long carbon chains in the humus (two times more CO2 as in the atmosphere), this is what gives the humus the black color. When humus is degraded, these carbon chains are digested and CO_2 released into the atmosphere. Especially in moors a huge amount of CO_2 is stored in the soil.

There are several ideas to store CO2 into the earth (CCS – carbon dioxide capture and storage) but we could do this easier and safer: we just have to bring back every organic material we use back into the soil. We do this with our green kitchen waste – but what about textiles from cotton or wool, paper from wood, shoes from leather?
These products are not designed for composting – but with Cradle to Cradle they would be. And we could compose our T-Shirts together with our sneakers or make biochar with it and store CO_2 in the soil for hundreds of years. In the same time the problem of Peak P would be solved, as humus is a perfect fertilizer and also contains of course phosphate.

2.8.2 Cascade use and Renewables

Renewable resources are sometimes discussed like "secret weapons" against everything. But no matter if we want to substitute plastic with bio-plastic, use wood as energy source or make bio-diesel from soybeans or palm oil – we have to deal with utilization competition (food, fodder, energy use or material utilization) und limited farmland. The results are rising prices, e.g. the prize of maize was so high in 2010, that people in Mexico could not buy enough of their basic food anymore. So even if these resources grow in a carbon neutral and ecological way, we have to be very careful using them.

Cascade use is the idea to make the most out of these resources. This is the way material flows can be managed through several defined products. Energy utilization should always be the last step in a long cascade of use, e.g. for wood we can recycle solid wood panels to veneer, to veneer stripes, chip boards etc. and so extend the period of use. Multiple material use is possible because of recycling of products and materials. In the end the organic material will be up-cycled again through natural processes (plant growth).

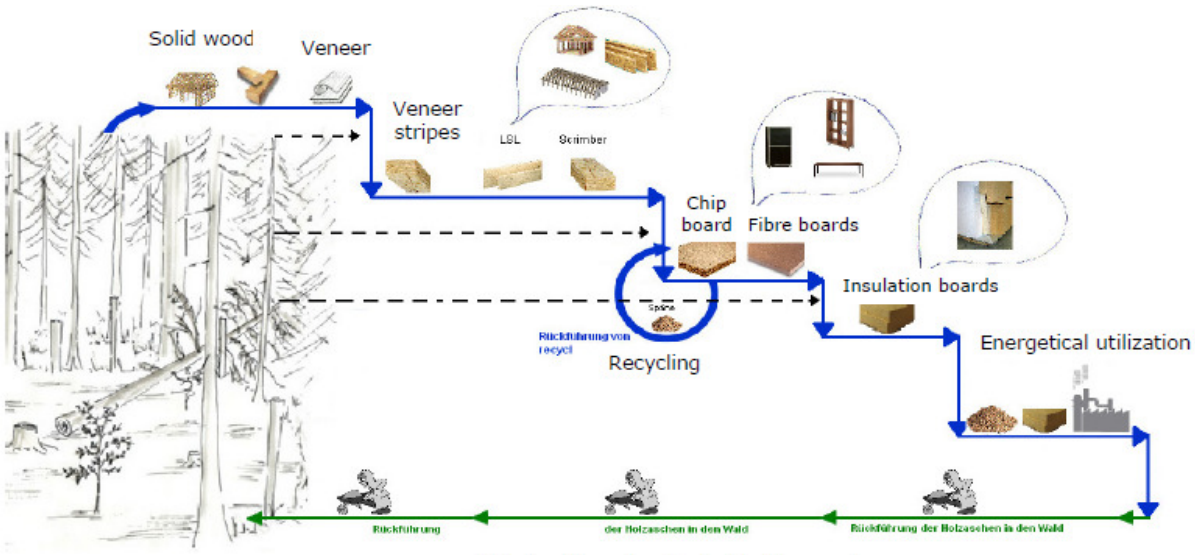
A tree needs 80 years to grow so this should be the minimum we use the material wood in a cascade.

For food like maize, the use as food has priority. Other material utilization should be reduced to side products and agricultural waste or better use algae instead.

No quick fixes – diversity is crucial

And with all this we always have to keep in mind the third basic principle – celebrate diversity. If we cut down tropical forests to plant oil palms - as happened in Indonesia - we always threaten biodiversity. And we also lose more CO_2 into the atmosphere as the marshy soil degrades with no protecting forest on top, than we can save by using biodiesel. The same is true for monocultures of maize, soybeans etc. We also have to have a close look on social impacts with the use of food as resource for products.

[14] A rock and a hard place, peak phosphorus and the threat to our food security. Soil Association http://www.soilassociation.org/LinkClick.aspx?fileticket=eeGPQJORrkw%3d&tabid=1259



Bringing the ashes back into the woods

Source: EPEA Hamburg

2.10 Critical Topics to Discuss

2.10.1 Misapprehensions

- Cradle to Cradle is not only about recycling. It is about bringing materials into metabolisms. This needs new design as well as material management ideas.
- Close the cycle does not necessary mean for one company to take back its own material. Other companies could also use this material – so that material flows from cradle (e.g. a car) to another cradle (e.g. sport article) to another cradle (e.g. chair).
- As it is a tedious way to design and make C2C products certification of a product according to C2C principles not necessarily means that everything is good. There are four certification levels, and only with level platinum all aspects are met completely.

2.10.2 Criticism

Criticism arose as McDonough and Braungart have kept C2C consultancy in their inner circle. Many critics would favor an open development. In response to this criticism the Cradle to Cradle product innovation institute was founded in California. It is responsible now for certification of products.
Also there is criticism that it will not be possible to really get all materials in cycles. According to the second law of thermodynamics, material losses will occur.

2.11 C2C and LCA[15]

Cradle to Cradle is a framework for innovation based on three guiding principles. Life Cycle Assessment, by contrast, is an assessment tool and not a universal design approach. It is designed for use as a measurement tool in eco-design processes.

An objective comparison is difficult because the two concepts do not share the same aims:

LCA: The aim is to provide a tool to help decision makers understand and improve the environmental impact of products and services. One aim is to identify environmental hotspots and identify alternative solutions with lower impacts. LCA is not a design concept. Instead it is designed for use as a measurement tool in eco-design processes for environmental impact. LCA includes all possible aspects of environmental impact over a products life cycle and looks at the whole product chain when analyzing the environmental performance of a product.

C2C: C2C states clear objectives at the beginning of the design process (three guiding principles). The question is not to avoid environmental hotspots but to make a product beneficial in all respects and with a positive footprint.
C2C is enabling companies to develop products and processes which actually create a positive environmental footprint (eco-effectiveness). C2C doesn't provide a common measurement tool.

But there are important differences:
- Direction for design solutions in LCA is depending on analysis of impacts, and not on the basis of guiding principles.
- LCA cannot measure the recyclability of a product. Recyclability is only relevant if the product is actually recycled; whether materials are suitable for recycling is not relevant.
- C2C aims for continuous flows of materials in the biosphere or the technosphere. This makes it very difficult to define the system boundaries, which is required for LCA.
- Under LCA, CO2 and its role in climate change play a very important role. From a C2C point of view, CO2 is a nutrient that has been mismanaged during recent decades and that should be managed – by supplying it to green houses or sequestering it into organic forms for use in topsoil, for example.
- The approach of using renewable energy in the whole product chain is one of the greatest challenges and also one of the main reasons why C2C products do not always perform well in an LCA. C2C aims for a quality statement which considers how energy is produced and how effectively it is used, whereas LCA considers the amount of energy used throughout the lifespan of the product.
- No in-depth toxicity data, Social aspects and water stewardship is taken into account in the LCA.
- In case an LCA talks about Human Health it talks about global impacts rather than local impacts.
- LCA is a simplified model of a complex reality fed by historical data and assumptions.
- LCA results are very difficult to understand and interpreted by non-scientific audience. It is not a good tool for public communication

2.12 C2C and CSR

(Please see 2.1, Discussion about C2C and Sustainability)

[15] *Usability of Life Cycle Assessment for Cradle to Cradle purposes. Position Paper 2011*

Time Table

Time (minutes)	Activity	Background/Material
15'	**Activity: "Pipeline"**	Build up a linear production line, encounter scarce resources, change to circular economy (Material: balls in different colors, half-pipes)
10'	**Input: C2C** **What is C2C and what not**	Slides
5'	**Learning from Nature**	Slides Discussion Excursion/Activity: Food chain in soil
	Input C2C Basic Principles	
30'-90'	**Principle 1: Waste equals food**	Example: show product which produces waste – show product which is a nutrient Picture: how does it work in nature (from leave to humus) Pictures: biological and technical cycle, examples Design for Disassembly Material Box from EPEA Hamburg (Creative Box for C2C Island Project) Handling Collection from Ellen MacArthur Foundation
10-45'	**Principle 2: Use current solar income**	e.g. group work about energy forms, role play: prepare a "television broadcast" from a new energy power plant
5'-30'	**Principle 3: Celebrate Diversity**	Why does this matter. Pictures: green roofs, urban gardening, carrot city etc. Group work/role play: social fairness in production Videos about ants from EMF
5'	**Video Three Principles**	e.g. Gugler, Maersk or others
30-45'	**Simplycycle Round 1**	First level: Learn vocabulary, biological and technical nutrient
	Input: **High Quality, Recycling instead of downcycling, ABC-X, Positive Lists, Management of material flow, Defined use period,**	
20-30'	**Simplycycle Round 2**	Second Level: Material Flow, Take Back of Material
	Input **Be beneficial, Positive Footprint**	Slides Examples of positive footprint
10'	**Input** **Eco-effectiveness**	Make the right things Example wood cascade Why actual recycling is more a down-cycling Example Degradation of soil, humus as Carbon storage with biological nutrients Example Copper in car doors, too little to recycling if efficient/ gold in mobile phones
20-45'	**Simplycycle Round 3**	Third Level: Be Beneficial, high quality
	Input **Peak P, compostable products against climate change**	
30'	**Activity: Group Work**	Discussion in class: what can you imagine our future to look like in a Cradle to Cradle way? Or make a reporter game out of this, ask your classmates or people on the street
20'	**Alternative Activity: How far do you come?**	Each student gets a card with a product (C2C or other). Ask questions like: is it made with renewable energy, can it be a nutrient – in which cycle?
30-90'	**Alternative Activity:** **Case Study**	Material: good examples, cards with questions to discuss

30'	**Alternative Activity: Change the concept of waste**	Students should collect the "Waste" from one week, see what they can recover, reuse. Discuss
	Alternative Activity: Garbology	Students are asked to imagine they are archeologists of the future, trying to learn about our civilization by straying the wastes we have left behind
20'	**Input and Discussion: Critical Topics to Discuss**	Slides
15-30'	Be Beneficial in the Region (Preparation for a project)	Collect problem fields in your areas
5'	**Saving the results**	What do you think about C2C? What did interest you about it, what do you like?

Material needed for this Module

Slides	
Video Maersk	http://www.youtube.com/watch?v=PRgp9tcOwaw
Description Activity Pipeline	
Description Case Study	
Description Activity How far do you come	
Video Story of Stuff	http://www.youtube.com/watch?v=9GorqroigqM
Research of Material Flow for Products	http://sourcemap.com/
Video Recycling by Desso	http://www.youtube.com/watch?v=7V90Jn5rVWk
Garbology	http://cwmi.css.cornell.edu/TrashGoesToSchool/Garbology.html
Toxics Lessons	http://cwmi.css.cornell.edu/TrashGoesToSchool/Toxics.html
Change the concept of waste – alternative exercise	http://cwmi.css.cornell.edu/TrashGoesToSchool/Trashor.html

Literature

NL Agency Ministry of Infrastructure and the Environment: *Usability of Life Cycle Assessment for Cradle to Cradle purposes. Position Paper, December 2011, page 29*
Cradle to Cradle pays off! NL Agency, The Terrace
Report Towards the Circular Economy, Ellen McArthur Foundation and McKinsey, 2012 http://www.thecirculareconomy.org/
Resilience in the Round, Aldersgate Group http://www.aldersgategroup.org.uk/reports
Plastiki Expedition

Ideas for Student Projects

- Composting Project of different materials: http://cwmi.css.cornell.edu/resources.htm#youthteacher
- Research good internet websites explaining toxic substances in household
- Home toxic survey http://cwmi.css.cornell.edu/TrashGoesToSchool/Household.html
- Trash goes to School http://cwmi.css.cornell.edu/TrashGoesToSchool/TrashIntro.html
- Garbology http://cwmi.css.cornell.edu/TrashGoesToSchool/Garbology.html
- Fieldwork: Walk in the forest, see how it works (or as video/pictures…)
- Make an event like "waste art" or a "T-shirt-Change-Day"

Additional Ideas

- Simulation Game "Fischteich" by Dr. Markus Ulrich, Switzerland
http://www.iconomix.ch/de/lehrmaterial/m06/
Experience of problems with management of renewable resources, here fish
Debrief Simulation Game: Overshoot/overexploitation and collapse – feedback loops
– Tragedy of the commons

Working and Learning in the World of Cradle to Cradle Chapter 3 How
Change and implementation
Script: drs. Rudolph Bolsius, KPC Groep

01 Frame:

How can we implement the Cradle to Cradle concept into our organization? How to change the mindsets of the participants in a more or less sustainable way?

How Cradle to Cradle should be imbedded in the vision and mission of an organization.

02 Goal:

Participants are aware of the fact that changing the mindset towards a Cradle to Cradle way of thinking and working is a complex process which demands a step by step approach.

Participants are aware of their own process of change.

Participants understand that complex change can be undertaken by using the CBAM(Concern Based Adoption Model) methodology.

Participants can use the CBAM model to implement Cradle to Cradle in their own organization.

Participants understand that implementing Cradle to Cradle in an organization is a dynamic interaction between bottom up working and top down decision making and planning.

03 Knowledge transfer

Principles of change by using the CBAM model.

New vocabulary (from awareness to refocusing in 7 steps) .

0.4 Key words

Concerns

CBAM model
Implementation **by change management**

Chapter 3 "How"

3. The essence of change

Implementing Cradle to Cradle in your own organization means change and change management.
Basic ideas about change are:

1. Change is a process, not an event.
2. Change entails multidimensional personal growth.
3. An organization does not change until the individuals within it change.
4. Change is a highly personal experience.
5. Change facilitation must suit individual needs.
6. Change is best understood in operational terms (who, what, when, why, how...).
7. Appropriate interventions reduce the challenges of change. Interventions are Actions (planned) and events (unplanned) that are key to the success of the change process.

8. Leadership is essential to long-term change success.

9. The context of the organisation influences the process of change.

3.1 The essence of the Concern Based Adoption Model

The essence is from raising awareness to changing the existing framework.
"Concern based" means motivated involvement to undertake radical changes in thinking and behavior.

The CBAM model describes how people develop as they learn about a radical innovation in thinking and behaving. The radical innovation in thinking an behavior takes place in stages/in steps.

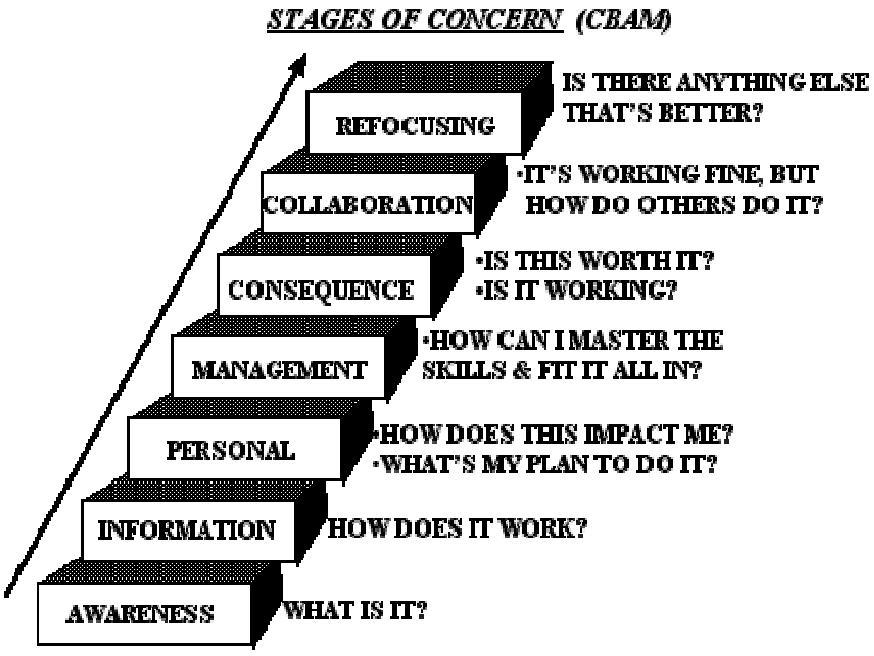
The specific character of Cradle to Cradle where you undertake a journey to a better situation needs some clear steps to be taken in order to be able to go through a complex process in changing the mindset. From linear thinking to circular thinking is quite a change in mindset!

The CBAM model defines these steps and helps the individual participants and the organization as a whole to get some grip on the complex process and to reduce feelings of uncertainty.

3.2 CBAM and the implementation of Cradle to Cradle®?

The „Stages of Concern" as described in the CBAM model defines the implementation of Cradle to Cradle in 7 stages in your organization or as a person.

During this proces a person's focus or concern shifts in rather predictable ways. To understand this process, start at the bottom of the image with "awareness" and read up each step plus the statement(s) next to each step. This individual
proces is in essence the same for an
organization as a whole.



1st This model points out the importance of attending to where the participants and the organization are in their way of thinking and working.

The essence is to start asking the questions mentioned above and to relate those questions to why do we need to do something different (see chapter 1).

So first the level of self concern(what is it? /how does it work?/how does it impact me?/ how can I fit it all in? and second the level from consequences till relations (see model above)

2nd This model suggests the importance of paying attention to the implementation process for several years.

So the personal life cycle in change and implementation needs support by a careful planning in the organization and also needs passion and vision driven managers.

Example Desso planning 2020: Mission and vision

All products are develloped according to Cradle to Cradle design criteria.

All materials and process inputs come from renewable or recycled sources.

All materials are capable of returning safely to either natural systems or industrial systems.

Establish unique,tailored take back and recycling systems for closing the loop.

Example Leonardo da Vinci project Cradle to Cradle

Participants need to have their self-concerns addressed before they are ready to attend hands-on workshops and go for it in the practice of their own organization.

Certainly the participants in the Cradle to Cradle project who need to act as change agents in their own companies need to feel secure before they go into the complex process of change.

When participants implement the new curricula in education or implement the Cradle to Cradle framework in their company the new approaches requires practice and support by their management.

So there should be a parallel process where the management and the particpants in this project should work together (mission and vision meets practice, planning ahead in goals meets individual passion and motivation).

3.3 Expression of concerns and behaviour

Concerns about the innovation can be expressed by individual employees,students and managers.

In a change process it is of the utmost importance to listen to participants because they tell you in what stage of concern they are in grasping the innovation.
When top managers want to involve their employees in the process from raising awareness to refocussing the innovation they also have to listen and look at the behavior of their employees.
So bottom up and top down it is in fact in essence the same process.

Typical Expressions of Concern

Stage of Concern	Expression of Concern
6. Refocusing	I have some ideas about C2C that would work even better.
5. Collaboration	How can I relate what I am doing to what others are doing?
4. Consequence	How can I refine C2C to have more impact?
3. Management	What about the role of management ?
2. Personal	How will using C2C affect me?
1. Informational	I would like to know more about C2C.
0. Awareness	I am not aware and not concerned about C2C.

Typical expression of Behavior

Level of Use	Expression of Behavior
VI. Renewal	The user is seeking more effective alternatives to the established use of C2C.
V. Integration	The user is making deliberate efforts to coordinate with others in using C2C.
IVB. Refinement	The user is making changes to increase outcomes.
IVA. Routine	The user is making few or no changes and has an established pattern of use.
III. Mechanical	The user is making changes to better organize the use of C2C.
II. Preparation	The user has definite plans to start using C2C.
0I. Orientation	The user is taking the initiative to learn more about C2C.
0 . Non-Use	The user has no interest in C2C ,is taking no action.

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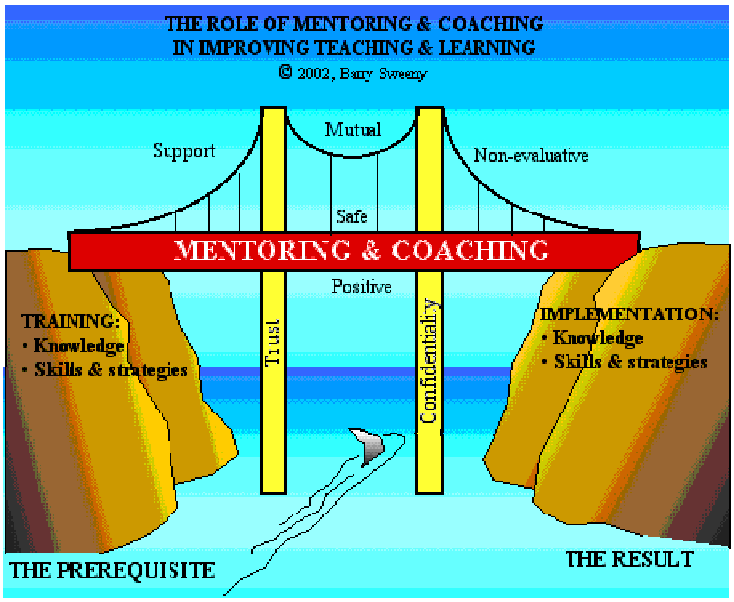

3.4 Training and implementation of Cradle to Cradle

The gap between training the participants and implementing Cradle to Cradle in their organizations and companies can be bridged by linking the Stages of Concern in the CBAM model and the "Bridge" in the training model.

The "Bridge" describes the sequence necessary for people to implement in practice what they have learned in training, and the role of mentoring in that process. It is a critical concept on which all developmental support efforts should be based.
When we compare the“ Stages of Concern“ model to the "Bridge" model , notice what we learn:

The 3 lower Stages of Concern occur at the training side of the "Bridge" (on the left in figure):
Awareness: what is C2C?
Information (how does C2C work?)
Personal (what is my plan to use C2C)

Also occurring at the training side of the "Bridge"(left in the figure) are skill development aspects , such as:
Demonstrations, participant practice and feed back moments.
This has to be organised by management.

3.5 Communities of practice:organise yourself compares the management stage in CBAM

Communities of practice have guiding principles and specific,methodology. You can ask questions like:
- What are the actual benefits of a Community of practice?
- What is the added value of bringing pioneers in the field of Cradle to Cradle together in one place?

There is a website hosted by the Leonardo da Vinci project (www.duurzaammbo.nl) and part of that website is a Community of practice. It is wise to start a Community per country to share the experiences about introducing Cradle to Cradle.

In the Community of practice *‘learning from one another’* is key.
Learning about how other companies implement Cradle to Cradle, how they have reached that point, and about the solutions they found to tackle the various challenges faced. Leading companies use one another as sparring partners, and through the Community of practice sessions they learn to speak a ‘common language. One success factor of the Community of practice is that the participants are not competing with one another.
For them an atmosphere of trust and confidence is needed.

“Learning from diversity” is another key concept in the Community of practice . The backgrounds and ambitions of the participants are different. They have different visions and opinions about whether Cradle to Cradle is the best or only way to achieve a better future, whether Cradle to Cradle goes beyond sustainability, or whether Cradle to Cradle is just one specific form of sustainability. There is also a huge variation in the size of the companies involved (from 15 to 50,000 employees); the stage in which implementation of Cradle to Cradle is in; and the extent to which Cradle to Cradle has been incorporated in their business processes.
They also differ in the scope of their ambitions; is the primary focus on certifying products, or is it an enterprise-wide strategy? Is certification being sought for existing, modified products, or are the Cradle to Cradle products a brand new addition to the assortment?

3.6 Try out: a small project on Cradle to Cradle

After the initial training the participants have some knowledge,some awareness,some skills and strategies for implementation but they have to bridge the gap between the prerequisite and the results themselves.
How? By organising your own small project on Cradle to Cradle. In the tool box of the project website there is a lot of information how to start your own (small) project. Always keep in mind the CBAM methodology.

3.7 Successful implementation

Successful implementation and application of Cradle to Cradle has profound effects on the organization. Cradle to Cradle is more than a sustainable product design – it is a philosophy, which can and must be embraced and applied by the entire organization.

The implementation of Cradle to Cradle therefore demands innovation and, in the longer term, *integral organizational changes*.

The Cradle to Cradle debate often focuses on the technical aspects of innovation.
But more is needed. The organization itself, and all of its employees, will have to operate differently.
Organizations must learn to develop *contextual awareness*, in other words they must become aware of developments in society and be able to translate them to business and (new) opportunities for products and services.
The organization– particularly the management – must also have sufficient *self-knowledge*. How do I manage and direct people? What are my strengths? How do I adapt to new situations? Cradle to Cradle requires after all new knowledge and a different style of leadership

in which openness and co-creation will play an important role.

4. The project:

4.1 Format for action

After chapter 3 with the introduction of change and innovation the particiants go back to their own organization and set up a small pilot project on a Cradle to Cradle way of thinking and operating.
A project to gain experiences, to feel what's going on and to explore possibilities.
This format is meant to be used and to act later on as a way of sharing.

Project Plan

Project Details

Date: Project :

Project Manager:

Project Name:

I. Introduction

II. Objective

III. Scope

Deliverables:	
Measures:	
Exclusions:	

IV. Work Breakdown Structure (WBS)

V. Roles

VI. Responsibilities

VII. Schedule

VIII. Budget

IX. Key Issues/Risks/Assumptions

X. Change Control

XI. Administration

Approval of the decision maker(s)

Name	Signature	*Date*

Time Table

Time (minutes)	Steps	Description/ Background	Material
15	**Introduction on change**		Power point
45	**How can we implement the Cradle to Cradle concept?**	Input: Think about a big change in your professional career/personal life? Can you describe what your experiences where at that moment?	-Socratic discussion on the essence of change. -Input: document the implementation of Cradle to Cradle from self centered to other centered behavior
15	**Introduction of the Goals plenary presentation**		See Chapter 3 Goals
30	**The essence of change**	Subgroup discussion	See Chapter 3
30	**The essence of the CBAM model**	The 7 steps in relation to personal change	Power points on stages of use/expression of concerns
30	**Bridge the gap**	From training to implementation	Power point the bridge
30	**Try out: the project**	Plenary and subgroup discussion	Power point format
15	**Evaluation and appointments**		

Material needed/available for this Module

Document The implementation of Cradle to Cradle			
Slides Chapter 3			
You tube films on CBAM			
Slides from Desso(planning)			-
Interview Rudi Daelmans Desso			
Interview Rob de Vrind KW1C			

Literature

The Implementation of Cradle to Cradle in steps		