IB Design Technology

HIGHER Topics 7-10

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Updated 25th May 2016- John Zobrist

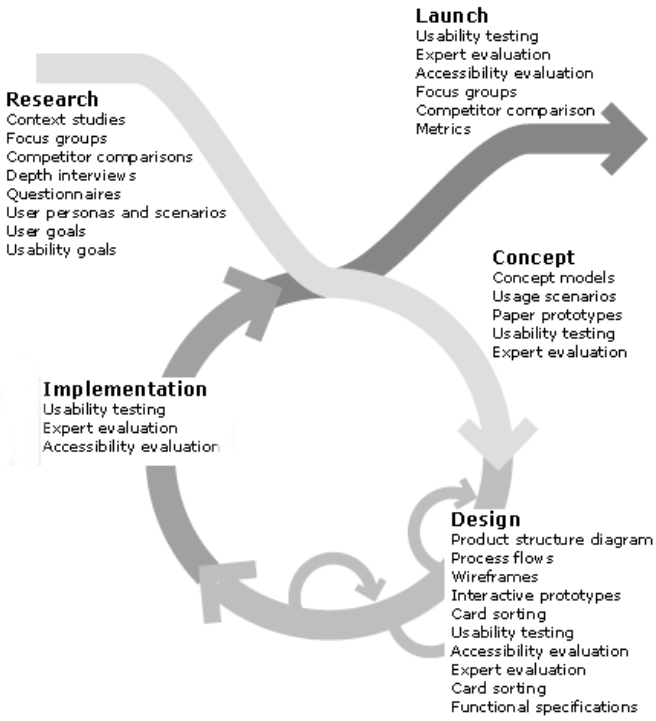
Topic 7
User-centred design (UCD)

7.1 User-centred design (UCD)

The fundamental principle of UCD is that understanding the needs of the users is the key to designing the best products and services. A designer must consider the needs, wants and limitations of the end user within every element of the design cycle. The ability to identify how users will interact with a product, service or system is vital for its success. To achieve this, designers must be able to acquire and analyse valid data without making assumptions about how the product may be used.

Main Idea	Description and Design Context
What is **UCD?**	The foundation of UCD is that good design requires that the **needs and capabilities** of the users are determined and incorporated into the design process from the **start through to the finish.** **Advantages of UCD** - UCD design is to put yourself in the user's shoes. - The design would be more intuitive. **Disadvantages of UCD** - User-centric design is expensive - Difficulty to translate certain types of data into design - Products takes more time - Item may be too complicated and specific for public use leading to becoming more expensive The product **must address the whole user experience**. Design should make it easy for the user to: • determine actions possible at any time • see the options and results of actions • determine current system state • follow intuitively from **intention** to **action**
The designer needs to have a deep understanding of the **user, task** and the **environment.**	**User-** the person utilising the product. The person who is being affected by the product or who is reaping the benefits or drawbacks of the product. A product can alter as well, depending on the user. **Task-** the thing the product is *supposed* to do… The user may have multiple uses for the same product. For eg a water bottle- the bottle may be designed for carrying water only, but the users may use it for other liquids such as milk etc. **Environment-** The place where the product is likely to be used- indoors/outdoors, urban/rural, on Earth/in space etc.
What is **Iterative Design?**	Iteration is the act of repeating a process with the aim of approaching a desired goal, target or result. Regular feedback from user would assist in making small changes to the product/design. Each repetition of the process is also called an "iteration", and the results of one iteration are used as the starting point for the next iteration.
The process is **iterative**, led by the user and developed through user-centred **evaluation**.	The process is iterative, **led** by the user and **developed** through user-centred evaluation. The design is developed through user-centred evaluation. For example, ISO stated the six principles that an iterative design should include: 1. The design is based upon an explicit understanding of users, tasks and environments. 2. Users are involved throughout design and development. 3. The design is driven and refined by user-centered evaluation. 4. The process is iterative. 5. The design addresses the whole user experience. 6. The design team includes multidisciplinary skills and perspectives

UCD design teams are multidisciplinary.
The five stages of UCD:
research, concept, design, implementation, launch
Inclusive design



UCD Design teams are multidisciplinary as only by incorporating into the development process the concerns and expertise of the user and production teams that manufacture, distribute, maintain and market the product could a good design emerge. The UCD process therefore represents a fundamental change in the traditional design process where design were developed largely in isolation.

UCD design teams may include anthropologists, ethnographers and psychologists.

Research	• Business and User problems and requirements are analysed. • The user, task and environment are considered • This can be done with a multi-disciplinary teams of ethnographer, anthropologists and psychologists • NB the above diagram for Research
Concept	• Initial ideas are put forward • Concept modelling takes place, including paper models • Allows for tactile and appearance evaluations • Evaluation is fed back into the design cycle • It is quick and cheap to carry out. • A multi-disciplinary team of designers, various engineers and psychologists. • NB the above diagram for Concept
Design	• Development of ideas • Scaled models such as prototypes, mock ups etc are made • Monitoring of performance against usability requirements • Allows for more continued evaluation by the user and design team. • Evaluation is fed back into the design cycle • NB the above diagram for Design
Implementation	• Various testing and evaluations are carried out with a wide range of end users ○ Evaluation is fed back into the design cycle • A multi-disciplinary team is used to measure the end-users psychological and physiological experience. • NB the above diagram for Implementation
Launch	• The end product is launched • Continuous evaluation is carried out • Monitoring of performance against usability requirements • NB the above diagram for Launch

What is **Inclusive design?**	-User-centred design has a focus on **inclusive design**. -Inclusive design requires designing universally accessible products for all users including those with **physical, sensory, perceptual** and other challenges and impairments. -Products and services **address the needs of the widest possible audience**, irrespective of age or ability. -It is important: The effects of rapidly **ageing populations**, and growing numbers of **people with disabilities**, are having a profound effect on new product and service development.

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7.2 Usability

Usability is about how easy it is to use a product or system. A design team should be "user" driven and frequent contact with potential users is essential. To understand how a product, service or system may be used, the designer must consider the prior knowledge and experience of the users, as well as their typical psychological responses. Evaluation methods that utilize appropriate testing and trialling strategies must be used to determine these aspects.

Main Idea	Description and Design Context
What are the **Usability objectives?**	Usability is defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness and satisfaction in a specified context of use". The primary objectives of usability are: • Ease of use • Efficiency of use • Unambiguous feedback • Clarity of human interface Usability objectives include usefulness, effectiveness, learnability, attitude (likeability).
Usefulness	- product enables user to achieve their goals - the tasks that it was designed to carry out and/or wants needs of user. Once users have learned the design, how quickly can they perform tasks? • Efficiently – fast and with minimum effort
Effectiveness	- quantitatively measured by speed of performance or error rate and is tied to a percentage of users. Use the design completely and accurately • Prevents errors • User can recover if errors occur.
Learnability	- user's ability to operate the system to some defined level of competence after some predetermined period of training. Also, refers to ability for infrequent users to relearn the system. • It is the ease at which the user can learn to use a product? • The intuitiveness to use a product, service or system design. • How easy is it for users to accomplish tasks the first time they encounter the design? • Memorable – when the user returns they do not have to re-learn how to use it
Attitude	- user's perceptions, feelings and opinions of the product, usually captured through both written and oral communication. • Satisfaction or likability when the client uses or interacts with the product, service or system design. • How pleasant is it to use the design?
What are the benefits of **Enhanced usability** and an give examples?	Benefits of enhanced usability include product acceptance, user experience, productivity, user error, training and support Enhanced usability increases: - **Product acceptance**: The knowledge that a product or service paid for will meet up to its defined specifications. - **User experience**: a person's perceptions and responses that result from the use or anticipated use of a product, system or service, this can modify over time due to changing usage circumstances. - **Productivity**: Developing products and services with the user in mind can reduce time wasting or difficult to understand aspects of a product. - Enhanced usability decreases: - **User error**: With simpler interfaces and controls, **user error is reduced** or even eliminated.

	- **Training and support**: If a product has a more intuitive user interface, a more pleasant user experience and simpler controls, there is **less need for training** and support to the consumer and so, reduced costs in these fields.
Characteristics of good user-product interfaces and an example?	Good user-interface design exhibits the following features: • low user error rate • high levels of user satisfaction • easy to learn-simple uncomplicated, uncluttered interfaces • easy to use-intuitive design, controls appear where anticipated and actions perform as expected • easy to remember functions and operations are performed over time with an ease of repeatability and high level of competence retention. Examples of good user-product interfaces for products include: 1. **Simplicity and ease of use** - Products with intuitive and easily accessible interfaces are likely to be more popular with consumers (especially more affluent and older consumers). 2. **Intuitive logic, organization and low memory burden**- Easy to use intuitive interface design allows new operators to quickly become competent in the basic operations of a product. Poorly designed, less intuitively organized interfaces place a high level of learning through trial and error. They also increase the memory burden placed on consumers who may use the product intermittently and be destined to repeat the learning process over. 3. **Visibility**- Colour, symbols of controls should be visible and it should be obvious how they work. 4. **Feedback**- Feedback is the **provision of information**, for example, an audible tone to a user, as a result of an action. The tone on a telephone touchpad or the click of a key on a computer keyboard provides feedback to indicate that a key has been pressed. 5. **Affordance**, Affordance is the property of an object that **indicates how it can be used**. Buttons afford **pushing**, and knobs afford **turning**. On a door, handles afford **pulling**, whereas push plates afford pushing. 6. **Mapping** - Mapping relates to the correspondence between the layout/space of buttons of the controls and their required action. 7. **Constraints**- Constraints limit the way that a product can be used. The design of a three-pin plug or a USB (universal serial bus) device ensures that they are inserted the correct way.
Population stereotypes	Population stereotypes are responses that are found to be **widespread** in a user population. Assumptions and associations are made by the population of a particular culture regarding how equipment and products operate. It is a concept relating to **cultural expectations**. It is the manner in which most people in the population expect something to be done. You might think of it as your intuition or your innate functional understanding of something. It is important to consider the intended User Population for any product (or system) you are designing. It can be defined as the range of users for a particular product or system. these can be defined by age, gender, physical condition, socio-economic class etc. Expectations that are found to be widespread in a population are known as conventions or stereotypes. E.g. USA vs. Europe with switches in houses and cars. Example includes the direction of handles to open and close and also the way switches are turned on or off.
What are the **advantages** and **disadvantages** of using population stereotypes for designers and users	**Disadvantages**: Making use of population stereotypes in the design might sometimes be irrelevant. For example, when a person walks into a room and want to turn a light switch on, the most common way for Americans is to turn it up, but in other countries, it is the opposite. **Advantages**: For many controls, certain actions we do such as turning, sliding etc will produce the expected result. Many users can operate a product without having to learn how to operate it.

7.3 Strategies for user research

The designer needs to understand the reasons behind the behaviours, wants, and needs of the user. Designers should select research strategies based on the desired user experiences in the context of the product, service or system. The purpose of user research is to identify needs that reveal the complexities of personae. Real-life scenarios that simulate "actual" user experiences can generate new findings.

<table>
<tr><th>Main Idea</th><th>Description and Design Context</th></tr>
<tr><td>User population</td><td>

User populations are a range of users for a particular product or system.
'Population' defined as the group expected to make use of an item, instrument, product or data.
Products may be designed for a particular user population, however there are many products designed for multiple population.

</td></tr>
<tr><td>Classification of users</td><td>

Users can be classified by age, gender and physical condition.
Allow designed to gather detailed feedback to generate insights for design development to each group.
Users can also be classified by interests, habits, nuances, emotional responses.

</td></tr>
<tr><td>The use of personae</td><td>
Personae is a profile of the primary target audience for a product.

Personae is created for these following reasons: to discover the needs of the customer, improve the quality of products, understand the customer profoundly, and identify which customer groups need to be valued.

<table>
<tr><th>Personas should:</th><th>Personas should NOT:</th></tr>
<tr><td>

be based on user research including contextual and individual interviews and systems observations
be based primarily on qualitative research
be focused on users' goals
be based on common behaviour patterns
be specific to your design context or problem
come to life, and seem like real people.

</td><td>

be focused on stereotypes or generalisations
be an 'average' of observed behaviour patterns.
be based on user roles
be based only on information gathered from subject matter experts, as they cannot represent end users.

</td></tr>
</table>
Essential details for defining personae include name, age, photo, information about family and home life, work environment, computer proficiency and comfort level with using Web, attitudes, motivation for using a high-tech product, information-seeking habits, personal goals
</td></tr>
<tr><td>What is Secondary personae?</td><td>Secondary personae are those who are not the primary target audience for a product, but whose needs the product should meet. They are able to provide valuable alternative insights to the development of a product.</td></tr>
<tr><td>What is Anti-personae?</td><td>Anti-personae are those for whom the product is not designed.</td></tr>
<tr><td>What is user research?</td><td>User Research focus on understanding the users behaviour and needs through observations, analysis and feedback.</td></tr>
<tr><td>How are Scenarios used as a strategy?</td><td>Scenario is an imagined sequence of events in the daily life of a persona based on assumptions by researchers and designers.

Scenarios provide physical and social context for different personae
Scenarios are based on best, worst and average case.
Simulates "actual" user experiences can generate new findings.

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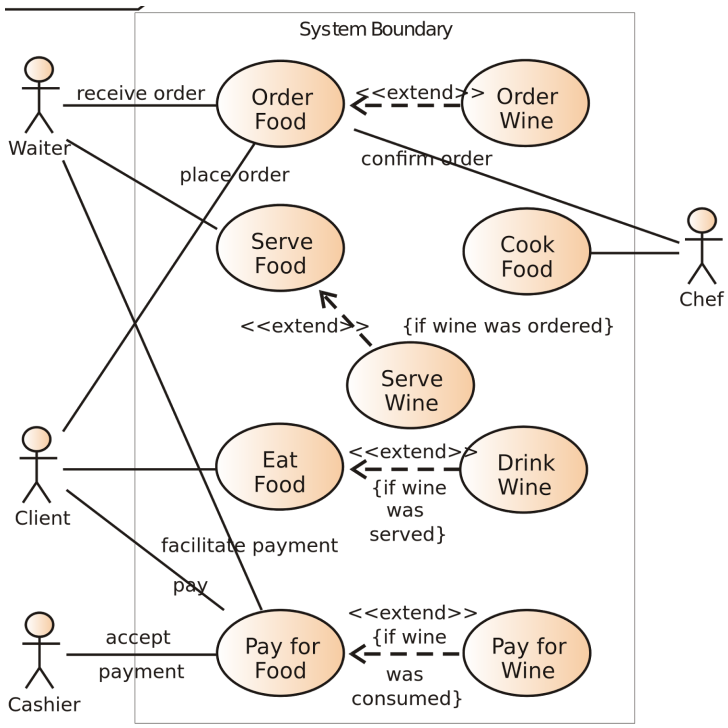
Use Case	Use case is a set of **possible sequences of interactions** or event steps **between a user and a product** to achieve a particular action.



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7.4 Strategies for UCD

Users have a central role in evaluating whether the product meets their wants and needs. For designers to successfully integrate usability into the design process, they require a holistic understanding of how a product, service or system is used. Designers must identify user requirements through the use of careful observation and interviews. A clear strategy for UCD will improve acceptability and usability, reducing costs and effort, while fulfilling user requirements.

<table>
<tr><th>Main Idea</th><th>Description and Design Context</th></tr>
<tr><td>What is Field research?</td><td>An observation of customer's user experience first hand, done by the firm. Essential for research to be conducted in the user's environment.
Useful when redesigning the product, as producers can fix the designs current problem
Can see what a user actually do in oppose to what they say they do
Downside is the cost of doing the field research, which is quite expensive to conduct
<table><tr><th>Advantages</th><th>Disadvantages</th></tr><tr><td>Gain first hand knowledge
Gain first hand experience
Obtain detailed data of people and processes
It emphasizes the role and relevance of social context.</td><td>Data will be very narrow
emotionally taxing as relationship between interviewer and client has to be established.</td></tr></table></td></tr>
<tr><td>What are Method of extremes?</td><td>Common way of defining the range of user population. Using this method, sample users are selected to represent the extremes of the user population plus one or two intermediate values.
Example, if you were choosing a door height, and pick the 95th percentile value, in other words, you would design for the taller people, then you wouldn’t need to worry about the average height people, or the 5th percentile, because they would fit anyways.
<table><tr><th>Advantages</th><th>Disadvantages</th></tr><tr><td>greatest number of users are accommodated</td><td>maybe sensitive for extreme groups to be involved</td></tr></table></td></tr>
<tr><td>How are Observation used as a strategy?</td><td>Observation: A collection of responses from users, as well a trail observation of users interacting with the product.
Essentially is a user trial where the intended client uses the product and the expert observes. This can be in the field (natural environment) or in a lab (controlled environment)<table><tr><th>Advantages</th><th>Disadvantages</th></tr><tr><td>Help to unveil usability issues
Tested under conditions of use</td><td>Data collected maybe difficult to analyse</td></tr></table></td></tr>
</table>

How are **interviews** and **focus groups** used as a strategy?

A collection of responses from users, a trail of observation of users interacting with the product.

Advantages	Disadvantages
• It is dynamic • Face to Face • Body language and gestures can be observed • Easily measure reactions • Clarifying questions can be asked	• Expensive as interviewees are often compensated • Participants may not wish to share sensitive issues • Small sample size may not be truly representative of the whole • Moderator bias

How are **Questionnaires** used as a strategy?

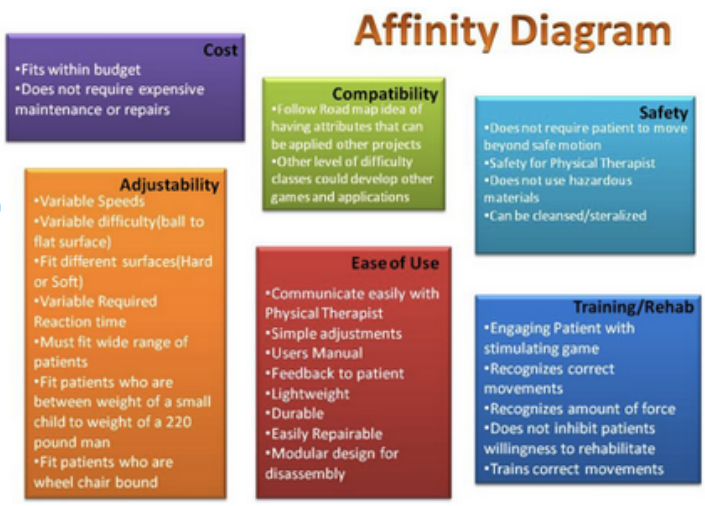
The method of obtaining user responses, through questionnaires to solicit information. One of the market research strategy, and user data collection techniques (supermarket surveys, questionnaires and interviews). User research is classed as Primary

Advantages	Disadvantages
• Cheap • Easy to administer • large numbers of questionnaires can be administered • sent easily to a wide local, national, global regions	• Static • poor number of responses • maybe only interested people fill out the survey thus perhaps a bias

What is **affinity diagramming** and how is it used?

Affinity diagramming is a tool used to organise ideas and information.

- A graphical tool that identifies a general theme to collect facts, opinions and ideas.
- They express data and infromation in a common format by creating clusters and groups of common information.
- It represents a text based map which shows aspects of the product that has been/will be taken into consideration in the design and manufacturing of the product, thereby presenting the results.



Advantages	Disadvantages
• Simple • Cost effective • Easy to get data from a group • builds teamwork	• time consuming • can get quite large

<table>
<tr><td>What is Participatory design</td><td>Involving the user in the design process. The target market perform realistic tasks, by interaction with paper versions of the final product.
An example of participatory design is when users representing the target market for a product perform realistic tasks by interacting with a paper version of the user-product interface manipulated by a person acting as a computer who does not explain how the interface works.</td></tr>
<tr><td>Prototype testing sessions</td><td>Making a testing product where all experiments are conducted before making the final product making all changes necessary that can be seen when the prototype is used. Example:</td></tr>
<tr><td>Usability testing sessions</td><td>The testing of a product with potential users to find out how usable the product is. Usability testing sessions in which a user group is monitored while they are made to test the product by another user group. Example: a user group who are using a microwave being monitored by another group evaluating how the first group is able to use the microwave in terms of speed and efficiency and understanding</td></tr>
<tr><td>Natural environments</td><td>Natural environment, is the monitoring of the user interacting with the product in their homes, or place of work or other natural product environments.</td></tr>
<tr><td></td><td>
<table>
<tr><th>Natural environments</th><th>Usability laboratories</th></tr>
<tr><td>• The potential client is observed using the product, system or service where it is intended to be used
• Advantage: solicit data from real and intended contexts
• Advantage: usability is tested in the intended environment
• Disadvantage: biased opinions from the observers
• Disadvantage: mostly quantitative data is collected.</td><td>• The potential client is observed using the product, system or service in a controlled.
• Advantage: controlled environment can ensure that product/service/system is used as intended.
• Advantage: Groups of ‘observers’ can view the usability and a more wider view of analysis
• Advantage: labs can be set up with high-tech sensors and equipment for better monitoring.
• Disadvantage: can be costly as facilities/personnel must be hired.
• Disadvantage: can be intimidating to know people are behind one-way mirrors</td></tr>
</table>
</td></tr>
<tr><td>Testing House</td><td>Typically a company that will test products on their site in a lab. Testing house has the environment set at the 'real' scenario. For example: it might be -10 degrees with snow and a user has to put up a tent wearing the clothing he/she would be wearing in that 'real' scenario...but it's not on the north pole but inside a controlled environment and the whole test is filmed and timed. This can be carried out in different parts of the world which can provide culturally biased usability issues.</td></tr>
<tr><td>Usability laboratories</td><td>Usability testing is carried out in an usability laboratory, and the test users are monitored by another group of observers in a different room. Example: Lab
For example: Usability laboratories is same but with no climate- put up same tent in standard room and it is filmed and timed. It's not -10 degrees and wearing normal clothing.</td></tr>
</table>

Compare **Testing houses** versus **usability laboratories**	**Advantages:** • Usability labs provide the best environment for people to observe and listen, either through one-way mirrors or through video cameras fed to large screens. • More people come to observe usability testing when it's conducted in a lab. Testing becomes more of an "event". The novelty of it, the comfort of the observation room, the free food, and the chance to get out of the office are all powerful temptations to get people to attend. It's always helpful to get people from the project team involved in observing the testing firsthand. • When more people come to observe testing, you can have debriefing sessions and discussions at various points during the day. • Usability labs give you the most control over the testing equipment, the environment, and the situation. You can ensure that each participant's experience is the same. That's important when you're doing a test that relies primarily on collecting quantitative metrics. • Labs allow you to have the most high-tech setup, with eye tracking, mobile usability testing equipment, multiple cameras, audio recording, etc. • Since the participants come to you, you don't have to travel, and you can fit more sessions in each day. **Disadvantages:** • A usability lab is a highly artificial environment. Taking people out of their normal context and bringing them into a lab does not show you their natural behavior. • Usability labs with the one way mirror, the cameras, and the observers can be intimidating and make participants feel uncomfortable. This can affect their behavior. Knowing that the designers and project team are observing can lead to the effect of participants telling you what they think you want to hear. • It's harder to get people to participate in a usability test when they have to come to a lab. It's easier to get them to participate when you can go to them or test them remotely. The best participants are often the ones that don't have time to come to a usability lab. Those who are able to come to a lab are sometimes less-than-desirable or, even worse, "professional" participants who supplement their income by participating in focus groups and usability tests. • Because people have to travel to the lab in person, your participants are limited to those in the immediate area. • Usability labs are expensive. Lab space and equipment cost a lot of money, making usability testing more expensive.

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7.5 Beyond usability-designing for pleasure and emotion

Usability is not the only factor for a designer to consider; products can be designed to evoke pleasure and emotion. A designer's ability to provide satisfaction through aesthetic appeal and pleasure can greatly influence the success of a product, service or system. Understanding attitudes, expectations and motivations of consumers plays a significant role in predicting product interaction. Designers need to be empathetic and sympathetic to user emotion, which acts as a critical component to determine how he or she interprets and interacts with a product, service or system.

Main Idea	Description and Design Context
Attitude	The perceptions, feelings and opinions about a product by a user. We want to create products that people love. To make it a pleasure to use – reduce complexity – it's usable! People become 'attached' to a product, they are engaged as a user/consumer in the product which will also develop brand loyalty (if a consumer is satisfied with the product, they'll come back which obviously increases or maintain sales for a company)
Four-pleasure framework	**The four pleasures** (socio-pleasure, physio-pleasure, psycho-pleasure and ideo pleasure) are used when products are designed to **evoke pleasure and emotion**.
Socio-Pleasure	Pleasure derived from being part of a group, i.e. gaining pleasure from being in a social group such as a member of the "PC Gaming Master Race" or being a "fan" of "Apple products". Other examples include: • Email, internet and mobile phones that facilitate communication between people. • Products may promote social interaction by being conversation starters, for example, jewelry, artwork or furniture. • Clothing can communicate social identity and indicate that a person belongs to a particular social group.
Physio pleasure	Pleasure derived from touching, smelling, hearing and tasting something. Ex.- the way something opens or physically feels like. Common products that invoke this type of pleasure are- knives, boxes, the texture of certain surfaces, the smell of new products like a car. Other examples include: • wearing a silk garment or the smooth feel of an iPod/iPhone, • taste such as eating chocolate • smell of leather, a new car, coffee or freshly baked bread
Psycho-Pleasure	Psychological pleasure is created when the person **thinks** about the situation, consciously or unconsciously. This can be created by intellectual games such as Sudoku or Scrabble that stimulate thinking and give the pleasure of 'winning'. The brain rewards itself with a shot of natural opiates when it sees patterns and learns, making this another powerful motivational approach. Other examples include: Examples include: • it might be expected that a word processor that facilitated quick and easy accomplishment of tasks would provide a higher level of psycho-pleasure than one with which the user was likely to make many errors. The former word processor should enable the user to complete the task more easily than he or she would with the latter.
Ideo-Pleasure	Pertains to people's **values**, refers to pleasure derived from our **ideals of life**, **aesthetics, culturally** and others. example: IKEA mug that has a groove at the bottom to let the water drain when drying. Other examples include: Examples include: • A product made from biodegradable materials might be seen as embodying the value of environmental responsibility.
Visceral design	Design that speaks to people's nature in terms how people expect things to work and how things are expected to turn out and how different ways of things acting are generally interpreted. Making the design **intuitive.**
Behavioural design	Is all about **use** and **understanding** how people will use a product, about **functionality** and is **fundamental** part of the design process.

Reflective design	Evokes **personal remembrance**, the message, the culture. example a watch being more than just a watch, rather being a fashion statement. A watch tells more than just time.
Design for Emotion	Design for Emotion will help your designs attract more attention and communicate your message more powerfully, to more people. Designing for emotion can increase: • User engagement • Product or brand loyalty • Satisfaction with a product by incorporating emotion and personality
Attract converse transact (ACT) model	A framework for creating designs that **intentionally trigger emotional responses**.
Attract	How it looks- Get someone to buy a product because they like the **aesthetics** of the product
Converse	How you interact- Converse is related to **interaction** and how increased interaction makes a generally better product
Transact	How it works- It is to either carry out or conduct a business for a transact relates to **function** and how increasing the function of a product makes a product in general better
Empathetic	When the designer takes the place of the user to see who potentially could use the product and the object could be better suited for the consumer. To empathize with potential users and so gain a better understanding of users' thoughts, needs, values and beliefs.
Sympathetic	The decisions required for the product to be the most helpful for the user given certain conditions.

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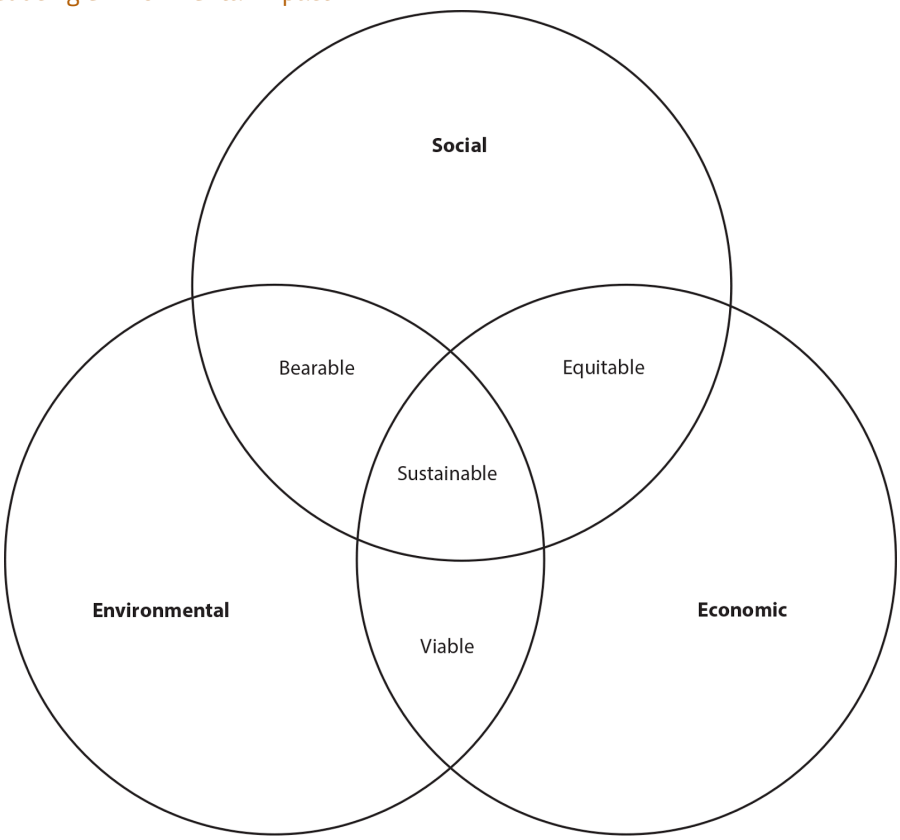
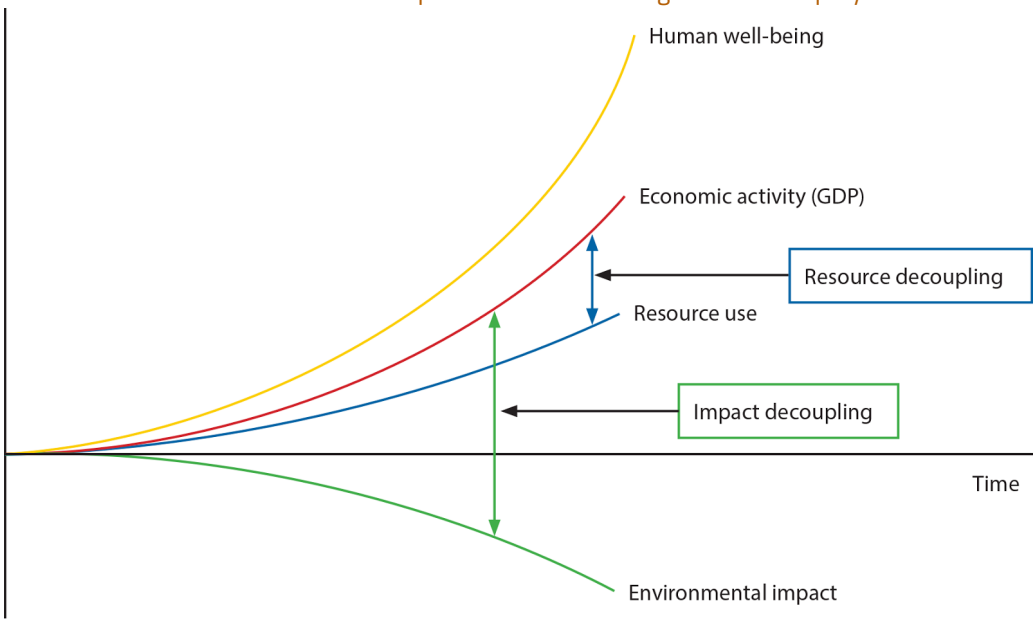
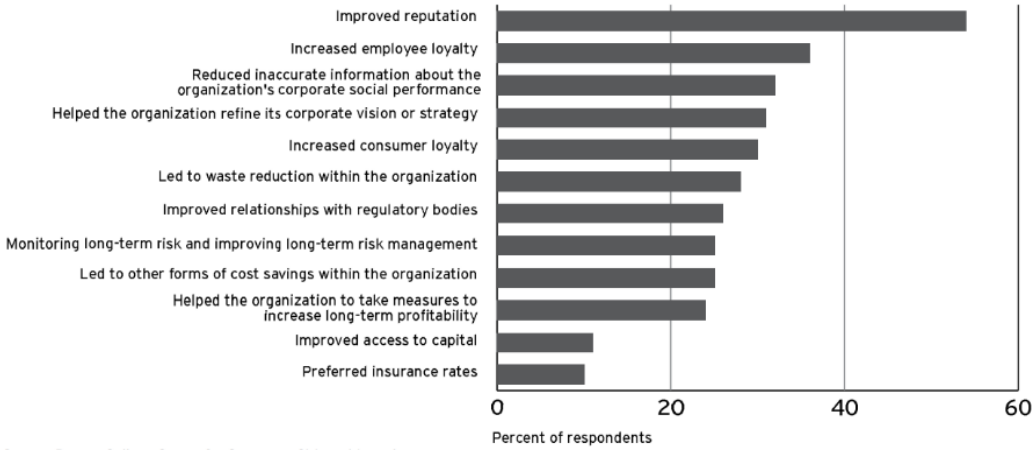
Topic 8
Sustainability

8.1 Sustainable Development

Sustainable development is concerned with satisfying human needs for resources now and in the future without compromising the carrying capacity of the planet. Designers utilize design approaches that support sustainable development across a variety of contexts. A holistic and systematic approach is needed at all stages of design development to satisfy all stakeholders. In order to develop sustainable products, designers must balance aesthetic, cost, social, cultural, energy, material, health and usability considerations. Triple bottom line sustainability does not only focus on the profitability of an organization or product, but also the environmental and social benefit it can bring. Organizations that embrace triple bottom line sustainability can make significant positive effects to the lives of others and the environment by changing the impact of their business activities.

Triple bottom line sustainability: environmental, economic and social.	Historically there has been a close correlation between economic growth and environmental degradation—as economic prosperity increases so environmental quality decreases. This trend is clearly demonstrated on graphs of human population numbers, economic growth and environmental indicators. Sustainable development frameworks enable the evaluation of the complex and interrelated concepts that are associated with development There is a correlation between economic development and human well-being. Design involves problem-solving to develop products and services to enhance human well-being. The importance of sustainability issues and strategies is critical to sustainable economic development. Economic development consumes resources, resulting in environmental impact. Designing for sustainability is dependent upon an understanding of the short- and long-term goals and values of individuals, institutions and governments. It is about the big picture that allows economic activity to rise while reducing resource use and reducing environmental impact. 

Decoupling Decoupling: disconnecting economic growth and environmental impact so that one no longer depends on the other	Decoupling refers to disconnecting two trends so that one no longer depends on the other. Through the act of decoupling (using resources more productively and redesigning production systems), it is technically possible to deliver the same or equivalent goods and services with lower environmental impact while maintaining social and equity benefits. 
Kyoto Protocol The use of international and national laws to promote sustainable development	An international treaty that sets binding obligations on industrialised countries to reduce emissions of greenhouse gases. The treaty was agreed in 1997 and came into force in 2005
Earth Summit in Rio de Janeiro (1992) The use of international and national laws to promote sustainable development	The UN sought to help Governments rethink economic development and find ways to halt the destruction of irreplaceable natural resources and pollution of the planet. The summit has produced results, making eco-efficiency a guiding principle for business and governments alik
International and national laws	Adopting a corporate strategy that has the support of shareholders/stakeholders can be difficult to achieve. International and national laws encourage companies to focus on aspects other than shareholder value and financial performance, which include transparency of corporate sustainability, transparent sustainability assurance and whether businesses, public services, national resources and the economy have the means to continue in the years ahead at a **micro** and **macro** level.
Sustainability reporting	A sustainability report is a company report that focuses on four aspects of performance. ▪ Economic ▪ Environmental ▪ Social ▪ Governance The reliability and acceptance of sustainability reporting requires accurate data gathering to be maintained over a lengthy period of time. Students need to be able to explain the benefits of sustainability reporting for governments, manufacturers and consumers. Benefits for manufacturers: Builds trust Transparency about environmental impact can help to reduce reputational risks, open up dialogue with stakeholders such as customers, communities and investors, and demonstrate leadership, openness and accountability. Helps to attract capital from green investors by identifying new markets and business opportunities. A growing number of companies see sustainability reporting as a means to drive greater innovation through their businesses and products to create a competitive advantage in the market. Better reputation Improves consumer brand loyalty.

	Meets the expectations of employees, improved morale. Increased efficiency In a 2012 global survey of sustainability reporters, 88% indicated that reporting helped make their organizations' decision-making processes more efficient. Benefits for consumers: Consumers want to know whether a company is performing in a globally responsible manner from an environmental perspective (e.g., water use, emissions, waste), and a social perspective (e.g., labor practices, human rights, corruption, customer health and safety). 
Product stewardship	Product Stewardship is an environmental management strategy that means whoever designs, produces, sells, or uses a **product** takes **full responsibility for minimizing the product's environmental impact** throughout all stages of the product's life cycle, including end of life management (disposal). Designers may need to respond to consumer pressure as more consumers become aware of resource issues and product labelling. Product stewardship requires all stakeholders involved in making, buying, selling or handling equipment to take responsibility for minimizing environmental, health and safety impact at all stages of the life cycle. E.g. Bodyshop & LUSH and also these examples below: ▪ organic foods ▪ genetically modified food ▪ green cotton ▪ forest stewardship ▪ bioplastics. **Manufacturers** In most cases, manufacturers have the greatest ability, and therefore the greatest responsibility, to reduce the environmental impacts of their products. Reducing use of toxic substances, designing for reuse and recyclability, and creating take back programs are just a few of the many opportunities for companies to become better environmental stewards of their products. Forward-thinking businesses have recognized that demonstrated corporate citizenship and maximum resource productivity are essential components to creating competitive advantage and increasing shareholder wealth (triple bottom line sustainability) **Retailers** As the sector with the closest ties to consumers, retailers are one of the gateways to product stewardship. From preferring product providers who offer greater environmental performance, to educating the consumer on how to choose environmentally preferable products, to enabling consumer return of products for recycling, retailers are an integral part of the product stewardship revolution. **Consumers** Ultimately, it is the consumer who makes the choice between competing products and using and disposing of products responsibly. Without consumer engagement in product stewardship, there is no "closing the loop." Consumers must make responsible buying choices which consider environmental impacts. They must use products safely and efficiently. Finally, they must take the extra steps to recycle products that they no longer need.

8.2 Sustainable consumption

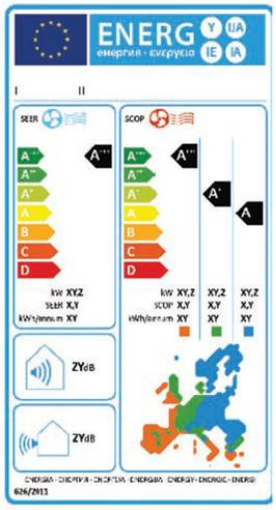
Sustainable consumption focuses on reducing the use of resources of a product to minimize its environmental impact. Designers develop products, services and systems that satisfy basic needs and improve quality of life. To meet sustainable consumption requirements, they must also minimize the use of natural resources, toxic materials and waste, and reduce emissions of pollutants at all stages of the life cycle. It is not only the role of designers to create markets for sustainable products. Consumers need to change their habits and express a want and need for these products.

Consumer attitudes and behaviours towards sustainability	Advantages and disadvantages of consumer and environmental pressure groups for the user, manufacturer and designer
Eco-warriors	Eco-warriors actively demonstrate on environmental issues. Eco-warriors protest anything that is damaging to the environment (such as animal cruelty and pollution). Greenpeace is an environmental organization that actively supports those protests and usually organize or join them. Examples of protests are members chaining themselves to trees and throwing red paint on fur coats.
Eco-champions	Eco-champions champion environmental issues within organizations. The Eco Champion will lead a Taskforce', a team of counselors from all parties, and the local community to listen to ideas and work together to tackle these problems. The group will look into areas such as what we consume, what energy we produce and use up, how we get around and how we can reduce and dispose of our waste.
Eco- fans (adopts)	Eco-fans enthusiastically adopt environmentally friendly practices as consumers. An Eco-fan is someone who accepts all new technological advancements for green design on the current market. An eco-fan will buy almost anything that is environmentally friendly and will never buy a harmful product. Products include, dolphin friendly tuna, aerosol spray cans that do not contain CFC propellants, cosmetics that have not been tested on animals, products packaged in environmentally friendly materials (reusable/recyclable).
Eco-phobes (resents)	Eco-phobes actively resent talk of environmental protection –Eco-phobes are people who are against helping the environment and purposely go against the ecological movements. They believe that the environmental problems are irrelevant to their lives, and some even believe that it is a scam. If you told an eco-phobe about environmental problems such as global warming, he would probably respond by saying "Is the earth warming? Oh, you betcha. Is Mars warming? Yup. Jupiter? Uh-huh. Will this freeze-thaw cycle continue happening into whatever "eternity" there may be? I'd have to say so." There are many theories that eco-phobes believe are true against helping the environment, but many of these theories are skeptical and are suspicious of many people. Some suggest that an example of an eco-phobe is George Bush, who refused to sign the Kyoto agreement which is based on controlling the Co2 output in a country to a limit in order to decrease global warming.
Eco-labelling	Eco labeling means that a legal organisation grants a special label (eco label) to a product. This label means that the product in question is very environmentally friendly. Many products now are labeled according to how environmentally friendly they are. Such labeling schemes have come about as a result of legislation and consumer pressure. They enable the consumer to compare potential purchases and make an informed choice.

Advantages of Eco Labelling	Disadvantages of Eco Labelling
For consumers, they're a shortcut to doing good: they're an easy to use, trustworthy guide to products that help the environment in some way. Second, for manufacturers, eco labels offer a potential point of difference and a competitive advantage. Many consumers take environmental performance into account so if a product looks eco friendly and doesn't cost much more, it's more likely to be lifted off the shelf. For manufacturers, making eco friendly products can make commercial sense. Third, labels encourage a general raising of environmental performance, even among products that aren't labeled. According to the International Standards Organization (ISO), the body that guarantees worldwide uniformity in the way we measure things, the objective of eco labels is: "...through communication of verifiable and accurate information, that is not misleading, on environmental aspects of products and services, to encourage the demand for and supply of those products and services that cause less stress on the environment, thereby stimulating the potential for market driven continuous environmental improvement." In simpler words, if environmentally friendly products sell better, all manufacturers have an incentive to produce them—and standards rise overall.	The biggest problem with a growing interest in ethical shopping is that manufacturers may be tempted to make exaggerated or misleading claims, which confuse consumers into thinking products are better than they really are. Instead of raising standards, the result is confusion among consumers and a systematic undermining of all eco friendly products (including genuine ones). This, of course, is exactly the problem that properly certified eco labels are designed to solve. For the system to work, ecolabels need to be trustworthy, trusted, simple to understand, and easy to recognize.

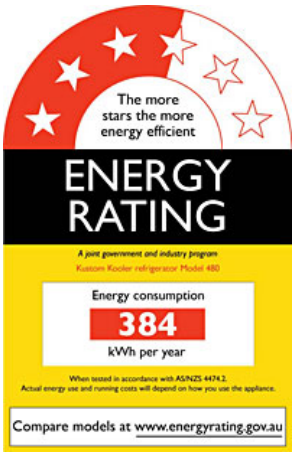
Energy labelling schemes

We need to consider how Energy labeling is different in different countries.



European union

If a company manufactures or sells household electrical equipment within the European Union, it must provide customers with the energy efficiency rating of your products by having a clear labeling on the product. As a consumer, if you are buying a household electrical item the energy efficiency rating should be displayed clearly on the product to help you make a better informed decision.

	Australia The Good Environmental Choice Label is the only environmental labelling program in Australia which indicates the environmental performance of a product during its complete lifecycle. The label is awarded to products that meet voluntary environmental performance standards which have been created and assessed in comparison to international environmental labelling standards. 
Creating a market for sustainable products:	Many shoppers want green products, but retailers and brand marketers are losing green sales at several key points along the path to a purchase. The largest opportunities to capture shoppers interested in green products involve; ▪ building awareness, ▪ educating shoppers, ▪ making green products easier to find and recognize, ▪ enhancing in-store communications and ▪ inspiring shoppers at the store shelf. As consumers increasingly demand green products, there is an incentive for marketers to offer them. It is important for firms to understand when consumers choose these products, and how to market them effectively. Ultimately it is the consumers choice as to which products they will buy (often based on price alone). It is important to; Create a market for sustainable products through; ▪ pricing considerations ▪ stimulating demand for green products ▪ production of green products
Pricing considerations	Green products that are more expensive than 'grey' products are not often purchased (cost can be decreased as more companies start using triple bottom line sustainability).
Stimulating demand for green products,	▪ Businesses could involve academics, pressure groups and the media to highlight current environmental crisis. This raises awareness to reduce overall consumption of environmentally damaging products. ▪ Engage in open dialogue with the public, consumers and government to rethink how society views consumption. ▪ Dialogue can encourage consumers to think about how lifestyle choices impact the environment, recognize sustainability implications of consumption and reduce reliance on products. ▪ Pay attention to market niches and demand to decide which green products to promote. For example, consumers have become increasingly concerned with buying organic food which has created a large market niche for supermarkets. ▪ Market green products as a way to build a responsible identity and lifestyle. For example, firms can encourage being a good mother by buying natural, organic foods for your children's health. ▪ Consumers buy products as a way to fulfill needs like self-identity and social relationships. Firms that market green products as a way to help "save the planet" or improve health of loved ones encourage consumers to fulfill these needs.
Production of green products.	A green plastic product might mean the company making the product can recycle the plastic (if it is ever returned or gathered). A sustainable product would not use traditional plastic (made from non renewable resources (oil)) but would use a bio-plastic made from plants or mushrooms that is made locally (reduced transportation need) in factories that use solar power for energy

Pressure groups	How consumer and environmental pressure groups can attract widespread support. How pressure groups exert influence for changes on these issues and support using the media (including social media). Pressure groups use a range of 'direct' and 'indirect' actions to promote environmentally sustainable policy. **Direct Action** Direct action entails physically attempting to hinder an activity that is seen as wrong, or gaining promotion through spectacular actions that aim to draw attention to environmentally damaging activity. Direct actions have in the past included the attempt by Greenpeace to scupper French nuclear testing in the south pacific by blockading the ship with their own vessel, 'The Rainbow Warrior', in 1985. This action resulted in an aggressive attack by French Special forces using mines. The ensuing explosions injured several crewmembers, one of which drowned to death. Following inquiries, the French foreign minister was disgraced and two French soldiers were found guilty of manslaughter. Following this, French nuclear bombings were halted aid public outrage and the rallying of private yachts in New Zealand, which further hampered French plans. It must be noted that direct action need not be dangerous or aggressive, although Greenpeace have at times been criticised for endangering activists. **Indirect Action** The overwhelming majority of pressure group action is 'indirect', involving the promotion of issues through education, debate and calculated lobbying. The Friends of the Earth have launched a campaign called 'The Big Ask', encouraging the public to directly lobby their local M.P's on difficult environmental issues, either in person, or through letter writing. It must be noted that indirect action is usually behind successful direct action, whilst direct action adds impetus to indirect action.
Lifestyle and ethical consumerism	Consider strategies for managing western consumption while raising the standard of living of the developing world without increasing resource use and environmental impact. Also how consumers have become increasingly aware of information provided by pressure groups and as markets have globalized, so has consumer power. Consumers might have been informed of the environmental factors of various products and become more conscious does not always translate into purchasing of sustainable alternatives due to some examples such as: **Lifestyle consumerism:** -a preferred criteria of brand due to recognition/reputation -the availability of product -the price of product rather than eco-label or energy label -the purchase of the product with the higher efficiency may influence the consumer by cost saving over the life/durability/impact on ecosystem/reduction in greenhouse gas emissions of the product -habit -trust -consumer lifestyle -product origin -company reputation **Ethical consumerism:** Being an ethical consumer means **buying products which were ethically produced** and/or which are not **harmful to the environment and society.** E.g. Fairtrade coffee or buying free-range eggs or as complex as boycotting goods produced by child labour and watching your food miles: how much energy was used getting the product to you? Products which fall into the ethical category include organic produce, fair trade goods, energy-efficient light bulbs, electricity from renewable energy, recycled paper and wood products with Forest Stewardship Council approval.

Take back legislation	Take back legislation puts the **impetus on manufacturers to deal with the product or waste at the end of it's lifecycle.** This can mean providing opportunities for recycling and collection, providing information to the consumer about disposal or directly dealing with the obsolete product.
Implications of **take-back legislation** for designers, manufacturers and consumers.	Take back legislation is the legislation that holds manufacturers responsible for the environmentally safe recycling or disposal of their end-of-life products. They are expected to provide a financial and/or physical plan to ensure that such products are collected and processed. Take back legislation comes in many different policy forms. For instance some legislation asks consumers to work with manufacturers to return products themselves for recycling. Implications of take-back legislation for **manufacturers and designers.** ▪ Once companies have to take products back, they become immediately interested in design for disassembly and recyclability because they are the ones doing the disassembling and recycling ▪ Manufacturers and designers have to make design changes that reduce waste, such as improving product recyclability and reusability, reducing material usage, and downsizing products. ▪ For instance, if a product has to be taken back and recycled by the manufacturers, it would be most advantageous for them to ensure the original design can be readily disassembled. ▪ Special care has to be taken with the choice of materials, costs, parts in order to make it easier for manufacturers to collect and recycle products. ▪ Some European countries have laws where stores must accept used packaging (from their store) on the spot. Customers love it because trash collection bills are very high in Europe and if you can leave your waste packaging at the store, you save money. The result? Increased customer satisfaction and an immediate reduction in product packaging Implications of take-back legislation for **consumers** ▪ If the cost of recycling a product is included in its price consumers can make more informed decisions about buying ▪ Some European countries have laws where stores must accept used packaging (from their store) on the spot. Customers love it because trash collection bills are very high in Europe and if you can leave your waste packaging at the store, you save money. The result? Increased customer satisfaction and an immediate reduction in product packaging Consider strategies for managing western consumption while raising the standard of living of the developing world without increasing resource use and environmental impact. In industrialized countries, the consumption patterns of cities are severely stressing the global ecosystem while settlements in the developing world need more raw material, energy, and economic development simply to overcome basic economic and social problems.

8.3 Sustainable design

Sustainable design is a philosophy of developing products in line with social, economic, and ecological sustainability principles. The first step to sustainable design is to consider a product, service or system in relation to eco-design and analyse its impact using life cycle analysis. The designer then develops these to minimize environmental impacts identified from this analysis. Considering sustainability from the beginning of the process is essential. Datschefski's five principles of sustainable design equip the designer with a tool not only to design new products, but also to evaluate an existing product. This can lead to new design opportunities and increase the level at which a product aligns with these principles.

Green design versus sustainable design

Green design began when consumers started to demand eco-friendly products as a result of concerns over damage to our environment. Green design refers to the **development** of products to have a reduced impact on the environment.
Sustainable design is based on the growing realization that what we have done so far is not enough. Sustainable products provide social and economic benefits while protecting **public health**, **welfare** and the **environment** throughout their life cycle—from the extraction of raw materials to final disposal.

Green Design	Sustainable Design
Products that have little or no effect on the environment.	Deals with TBL sustainability, economic, environmental & Social
Cradle to the grave approach	Cradle to cradle approach
Shorter (than sustainable design) therefore easier and cheaper to address environmental concerns in products.	Longer timescale which can affect the R & D stage (system wide research needed) of the design process increases costs therefore may not be feasible.
Incremental idea generating techniques are feasible as possibly only small changes need to be made.	Idea generating techniques are more radical to re-think (over-haul/redesign) the nature of the product and how it works

Datschefski's five principles of sustainable design:

'The total beauty of sustainable products'

Is the name of a book by philosopher and design guru Edwin Datschefski.
In it he describes five simple tests for sustainability - cyclic, solar, safe, efficient, social

There are five design requirements for sustainable products. The first three mimick the protocols used by plant and animal ecosystems:

- **Cyclic**: The product is made from organic materials, and is recyclable or compostable, or is made from minerals that are continuously cycled in a closed loop. The idea here is that there should be no such thing as waste. All by-products should be the 'food' for something else, just like photosynthesis. Metals can be recycled again and again. Something that really has to be thrown away might be burned to release the energy 'locked up' in it. Biodegradable materials can be composted to provide nutrients for the soil. In this way carbon and nitrogen can re recycled.

- **Solar**: The product uses solar energy or other forms of renewable energy that are cyclic and safe, both during use and manufacture. The sun can give us energy directly through photovoltaic cells, and through using other types of solar panels. But wave and wind power are also the product of the sun's energy. Hydro-electricity is made possible by rain falling: again this is powered by the sun. Biomass can be converted into energy. The sun makes plants grow, and we eat the plants (or animals that have eaten the plants). Thus, our energy comes indirectly from the sun. Also we can burn biomass to generate heat energy.

- **Safe**: The product is non-toxic in use and disposal, and its manufacture does not involve toxic releases or the disruption of ecosystems. Are all releases to air, water, land or space the 'food' for other systems? A safe product or process is one that does not harm other people or life, physically or chemically. You need to consider the whole life cycle of the product - the raw materials, extraction and manufacturing processes, the transport involved, the impact of distribution, sale, use (and misuse!) and ultimate 'disposal' of the product. A totally safe product generates nothing harmful, nor any waste, at any stage. We need also to think of the social impact of the product or process - see point 5 below.

The fourth requirement is based on the need to maximise the utility of resources in a finite world:

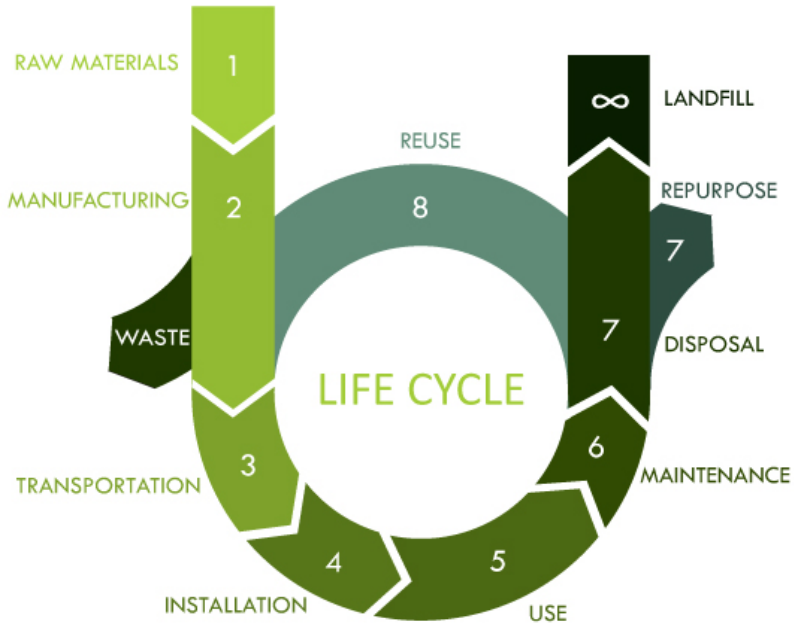
- **Efficient**: The product's efficiency in manufacture and use is improved by a factor of ten, requiring 90% less materials, energy and water than products providing equivalent utility did in 1990. Every product requires energy, materials and water for its production and use. Can an equivalent or better product be produced with less?

  We need to reduce our use of energy, materials and water by up to 90%. In the long term, is the product economic to make? Or does it create problems that someone else will have to pay for in the future?

And the fifth recognises that all companies have an impact on the people who work for them and the communities within which they operate:

- **Social**: The product and its components and raw materials are manufactured under fair and just operating conditions for the workers involved and the local communities. Does the product manufacture and use support basic human rights and natural justice?

  Are the working conditions safe and compatible with human dignity? Are people paid properly at all stages of the supply chain? Does the product reinforce equality of opportunity? Does it enhance cultural diversity? Does it encourage participation in society?



'History should be our guide. The United States led the world's economies in the 20th century because we led the world in innovation. Today, the competition is keener; the challenge is tougher; and that is why innovation is more important than ever. It is the key to good, new jobs for the 21st century. That's how we will ensure a high quality of life for this generation and future generations..'
PRESIDENT BARACK OBAMA, AUGUST 5, 2009

8.4 Sustainable Innovation

Sustainable innovation facilitates the diffusion of sustainable products and solutions into the marketplace. Sustainable innovation yields both bottom line and top line returns as developing products, services and systems that are environmentally friendly lowers costs through reducing the resources required. Designers should view compliance with government legislation as an opportunity for sustainable innovation. As energy security becomes an ever more important issue for all countries, designers, engineers and inventors need to develop new ways of efficiently generating energy. As new energy production technologies become available, designers need to harness them to be used in new products to improve their energy efficiency.

Complexity and timescale of sustainable innovation	Sustainable innovation relies on cooperation between different stakeholders such as government and manufacturing. It is the broadest approach going beyond technical solutions. This approach is based on a socio-technical systems intervention rather than just considering product improvement. The huge timescale means that **sustainability is difficult to maintain** as conditions/criteria can change significantly, for example, a lengthy period of economic downturn. • This is often difficult as both parties have differing views. • Sustainable innovation requires a radical change which is time-consuming and expensive so manufacturers are not so willing to consider sustainable innovation. • Sustainable innovation is a hugely complex concept that requires a long time for implementation, typically 20–40 years depending on the nature of the innovation.
Sustainable Top-down strategies	At its most basic, this is the breaking down of a system into component parts. From a corporate strategy perspective, a top-down strategy means that the leadership level will determine the goals and how each department and/or individual employees will contribute to meet those goals. When considering sustainable innovation, designers are usually more comfortable with top-down strategies as it means investment and resources are more predictable and reliable. • **Top-down is controlled by government**. E.g. ban plastic bags in shops in Singapore. • Management of resources, finances (controlling bank rates, etc) and so on. • It provides targets and measures for sustainability.
Sustainable Bottom-up strategies	At its most basic, this is the piecing together of components or systems in order to give rise to a more complex system or product. From a corporate strategy perspective, a bottom up strategy methodology means that the leadership level will determine the overall goals, but the workforce will assist in developing the mechanisms and ideas to meet that goal. • Strategies implemented from the 'bottom' such as **regional or local** (city or town) level. E.g. These include local initiatives like Planting Tree Campaigns • **Designers are involved with bottom-up strategies** are usually enthusiasts for the project and willing to make a commitment even though it may not be cost-effective to do so. Students are expected to be able to identify examples of bottom-up strategies and evaluate the advantages and disadvantages for consumers/users. • A potential problem for designers is the changing political scene and associated policies, for example, within the domain of renewable energy.
Government intervention in innovation	There are various strategies that governments use to promote knowledge exchange and technology transfer. Government intervention includes: 1. **regulation**—setting and policing rules to avoid or limit environmental issues caused by undesirable technologies 2. **education**—providing consumers with information and guidance in the choice of products and services that are more sustainable 3. **taxes**—to penalize environmentally damaging technologies and influence consumer choice of sustainable products and services 4. **subsidies**—to stimulate and support sustainable innovations.
Macro energy sustainability	Macro energy sustainability can be influenced through international treaties and energy policies, instruments for change and disincentives, and national systems changing policy when government leadership changes. Macro-sustainability is the area of **sustainable development** that focuses on how a **nation, region or the entire world would establish large scale behaviors for sustainability**

<table>
<tr><td></td><td>E.g. the Kyoto Treaty would fall into this category. Kyoto Protocol on the reduction of green house gases. In order for it to be successful all governments need to agree, for a while Australia and USA did not so many countries followed suit

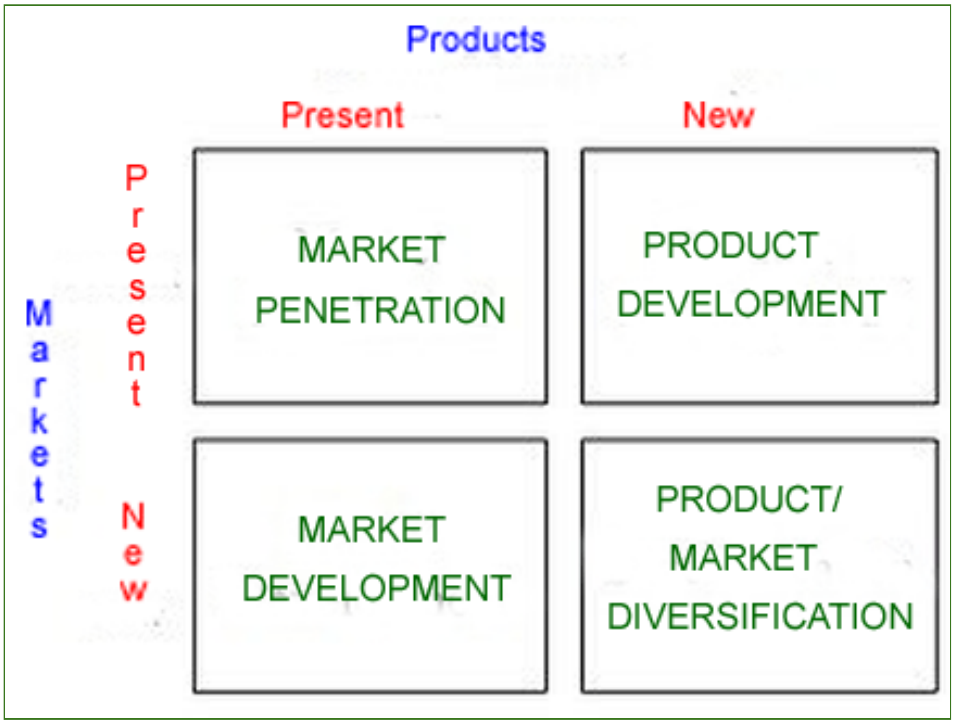
Macro energy sustainability
How macro energy sustainability can be influenced through:
international treaties and energy policies
instruments for change and disincentives
national systems changing policy when government leadership changes</td></tr>
<tr><td>Micro energy sustainability</td><td>Micro energy sustainability can be influenced by the role of the government in raising awareness and changing attitudes, and promotion of individual and business action towards energy sustainability. Micro energy sustainability can be influenced by:
the government raising awareness and changing attitudes
promotion of individual and business action towards energy sustainability
E.g. Local governments installing Combined Heat and Power (CHP)</td></tr>
<tr><td>Energy security (energy demand)</td><td>Energy demand is rarely constant and this puts a responsibility on those that generate and manage the flow of energy to understand when peaks and troughs of energy use occur over the course of days, weeks and years. For example:
In many countries, energy demand increases substantially during breaks and following popular TV shows as large numbers of people put the kettle on to enjoy a hot beverage.
Also, there may be particular periods during the night where energy use is at a minimum. In these situations it is vital that the power-generating stations are informed when to start and stop energy generation.
The difficulty arises as massive amounts of electricity cannot easily be stored, excess energy generated at these times is wasted.
Demand/supply trends need to be predicted carefully to create a responsive and efficient energy supply.</td></tr>
<tr><td>Smart Grids</td><td>A modernised electrical grid that uses analogue or digital information and communications technology to gather and act on information (such as behaviours of suppliers and consumers) in an automated fashion to improve the efficiency, reliability, economics and sustainability of the production and distribution of electricity. They can be national or international. International grids allow electricity generated in one country to be used in another.

<table><tr><th>Advantages of Smart Grid</th><th>Disadvantages of Smart Grid</th></tr><tr><td>-Mostly electromechanical
-One-way communication
-Mostly centralised generation
-Sensors are not widely used
-Lack of monitoring: manual
-Failures and blackouts
-Lack of control
-Less energy-efficient
-Usually not possible to integrate with renewable energy
-Customers have less scope to modify uses</td><td>-Digital in nature
-Two-way communication
-Distributed generation
-Sensors are widely used
-Digital self-monitoring
-Adaptive and intelligent
-Robust control technology
-Energy efficient
-Possible integrate large scale renewable energy
-Customers can check uses and modify</td></tr></table></td></tr>
</table>

Topic 9
Innovation & Markets/Corporate Strategies

9.1 Corporate Strategies

Companies and businesses can utilize a range of different strategies to develop products, services and systems. The success of a company relies heavily on the strategies it adopts. The evaluation of products, services and systems can inform the selection of the most appropriate strategies to follow that will enable a company to achieve its objectives.

Pioneering strategy	Being the first to market with a new innovation. Pioneering means being ahead of the competitors by introducing a new product first. This strategy has the potential for high profit if the product is successful **James Dyson Cyclone Vacuum Cleaner, James Dyson Bladeless Fan,** **Lego bricks, Tesla hybrid car**
Imitative strategy	Developing products that are similar to an existing new product. The imitative strategy aims to develop a product similar to the 'pioneered' product as quickly as possible. It takes advantage of all the R&D invested by others. Developing Products that are similar to an existing new product. Examples: **Lego and Megabloks** **Duallit Toaster, GoPro Camera and yicamera and sony camera**
The **Ansoff Matrix** (not in the guide but aids understanding of the framework for marketing)	The Ansoff Matrix also known as the Ansoff product and market growth matrix is a marketing planning tool which usually aids a business in determining its product and market growth. This is usually determined by focusing on whether the products are new or existing and whether the market is new or existing. The model was invented by H. Igor Ansoff. Ansoff was primarily a mathematician with an expert insight into business management. It is believed that the concept of strategic management is widely attributed to the great man. The Ansoff Matrix has four alternatives of marketing strategies; Market Penetration, product development, market development and diversification. 

Market development	Finding new applications for existing products, thereby opening up new markets. Increasing sales to existing customers or finding new customers for an existing product. Examples: This marketing strategy may also be known as Market Extension. In this strategy, the business sells its existing products to new markets. This can be made possible through further market segmentation to aid in identifying a new clientele base. This strategy assumes that the existing markets have been fully exploited thus the need to venture into new markets. There are various approaches to this strategy, which include: New geographical markets, new distribution channels, new product packaging, and different pricing policies. In New geographical markets, the business can expound by exporting their products to other new countries. It would also mean setting up other branches of the business in other areas that the business had not ventured yet. Various businesses have adopted the franchise method as a way of setting up other branches in new markets. A good example is Guinness. This beer had originally been made to be sold in countries that have a colder climate, but now it is also being sold in African countries. The other method is via new distribution channels. This would entail selling the products via e-commerce or mail order. Selling through e-commerce will capture a larger clientele base since we are in a digital era where most people access the internet often. In New Product packaging, it means repacking the product in another method or dimension. That way it may attract a different customer base. In Different pricing policies, the business could change its prices so as to attract a different customer base or so create a new market segment. Market Development is a far much risky strategy as compared to Market Penetration. This is so as it is targeting a new market and one may not quit tell how the outcome may be.
Product development	The creation of new, modified or updated products aimed mainly at a company's existing customers. Examples: **Victorinox Swiss Army Knife, Iphone 5 to Iphone 6, Swatch watch, GoPro** In product development growth strategy, new products are introduced into existing markets. Product development can differ from the introduction of a new product in an existing market or it can involve the modification of an existing product. By modifying the product one would probably change its outlook or presentation, increase the products performance or quality. By doing so, it can appeal more to the already existing market. A good example is car manufacturers who offer a range of car parts so as to target the car owners in purchasing a replica of the models, clothing and pens.
Market penetration	Increasing sales to existing customers or finding new customers for an existing product. Market penetration is a tool used to determine the potential growth available for product sales. **Calculation**: product sales/total market potential When we look at market penetration, it usually covers products that are existence and that are also existent in an existing market. In this strategy, there can be further exploitation of the products without necessarily changing the product or the outlook of the product. This will be possible through the use of promotional methods, putting various pricing policies that may attract more clientele, or one can make the distribution more extensive. In Market Penetration, the risk involved in its marketing strategies is usually the least since the products are already familiar to the consumers and so is the established market. Another way in which market penetration can be increased is by coming up with various initiatives that will encourage increased usage of the product. A good example is the usage of toothpaste. Research has shown that the toothbrush head influences the amount of toothpaste that one will use. Thus if the head of the toothbrush is bigger it will mean that more toothpaste will be used thus promoting the usage of the toothpaste and eventually leading to more purchase of the toothpaste. When you develop the products in a way new market segments can be targeted. Thus increasing sales to the existing users/ clients or increasing the number of users targeted.

	This strategy involves changing with the pricing or the quality of the good. Can also involve changing the quantity supplied per unit, changing the price of the good. (eg Oreos in China) Victorinox- knives, bags, watches, wallets, etc. Iphone 6+: Was created for the Asian Market as they wanted larger screens.
Product diversification	The process of setting uniform characteristics for a particular product, system or service to help increasing sales. It involves the modification of an existing product so that its market potential can increase. Example iPhone(small and large size) or involves a company both in the development of new products and in selling these products to new companies. It is when firms offer different products in order to increase sales: selling to previous consumers as well as selling to new customers. Nestle→ Diversifying to making cornflakes, Milo, Hot Chocolate, Chocolate etc **Victorinox: Originally produced knives, now produce wallets, key holders and other accessories.** **Apple: Laptop, iPod, etc Product family, Swatch- Swatch car** **Lego: Technik, NXT, Duplo, Wedo** The last strategy is Diversification. This growth strategy involves an organization marketing or selling new products to new markets at the same time. It is the most risky strategy among the others as it involves two unknowns, new products being created and the business does not know the development problems that may occur in the process. There is also the fact that there is a new market being targeted, which will bring the problem of having unknown characteristics. For a business to take a step into diversification, they need to have their facts right regarding what it expects to gain from the strategy and have a clear assessment of the risks involved. There are two types of diversification. There is related diversification and unrelated diversification. In related diversification, this means that the business remains in the same industry in which it is familiar with. For example, a cake manufacturer diversifies into a fresh juice manufacturer. This diversification is in the same industry which is the food industry. In unrelated diversification, there are usually no previous industry relations or market experiences. One can diversify from a food industry to a mechanical industry for instance. A good example of the unrelated diversification is Richard Branson. He took advantage of the virgin brand and diversified into various fields such as entertainment, air and rail travel foods etc. Another example is the Easyjet which has diversified into car rentals, gyms, fast foods and hotels. Though diversification may be risky, with an equal balance between risk and reward, then the strategy can be highly rewarding. Another advantage of diversification is that in case one business suffers from adverse circumstances the other line of businesses may not be affected.
Hybrid approaches	When multiple previously mentioned strategies are used at once. Most common and practical one. An example is the MpMan - digital audio player (manufactured in South Korea), multiple companies attempted to capture the growing Mp3 player market
The relative **success** of pioneering and innovative strategies	James Dyson Vacuum Cleaner is an example of pioneering strategy. Research shows that the majority of product and service pioneers rarely reach market dominance due to being unable to capitalise. Sony's Betamax failure to capture market dominance is another high profile example of an imitator such as JVC achieving market success. Innovation is achieved when the product has been successful in the marketplace.
Corporate social responsibility	Corporate social responsibility is a form of self-regulation for a company that centres around the development of goals related to three areas: economic; social; and environmental. A corporate strategy within a company's strategic vision for the future includes responsibility for its actions, socially, ethically and environmentally. (Economic, Social, Environmental). E.g. Ben and Jerry's ice cream.

Comparison of success between pioneering and imitative strategies	The imitative strategy aims to develop a product similar to the 'pioneered' product as quickly as possible. It takes advantage of all the R&D invested by others. Pioneering involves charting a new or innovative course; whereas, imitative strategies is to create a product based on a few existing ideas. Facebook, Lego and Sony Walkman as an example?
What is the result of a hybrid strategy	If a company has a hybrid corporate strategy it will adopt an expensive and risky pioneering strategy for some products and a cheaper and safe imitative strategy for others.
What is the aim of corporate social responsibility	Refers to a company's approach for the future. Often involves an assessment of the current situation and mapping of the policies and procedures to achieve predetermined goals." - goals may be long term or short term, production-based, environmental, financial or competition. The designer/company needs to consider the ethical implications of imitating the products of others and their implications on cultural, economic, and intellectual property level. Examples include use of Leather/fur, Animal testing (body shop/cosmetics), Labour camps/Sweat jobs, Fair Trade, etc.

Notes:

9.2 Market Sectors and Segments

Designers must research and consider the target market sectors and segments in the design of their products. Designers must consider the market when targeting their product, service or system. The smaller the sector, the more the target audience will have in common. Companies may decide to compete in the whole market or only in segments that are attractive and/or familiar. A designer's understanding of the identified market is essential.

General **market sectors**	A broad way of categorizing the kinds of market the company is aiming for. e.g. education or medical
Geographical sectors	Geographical sectors identify purchases in a particular region. Characteristics might be region, value and cultural-specific. Consumers' needs vary from one climatic region to another. eg. durian flavoured Oreo in South East Asia, green tea Kitkat in Japan
Client based sectors	Focus on consumers, whether they be individuals or groups, industry related, commercial or government run enterprises. e.g. teachers or nurses
Mass market	Produced on a large scale, a product that is available to a large amount of people and can be used by anyone. Available as a 'Global brand'e.g. Franchise food brand: McDonald, KFC, starbucks, Apple, Samsung, LG
Market segments	Markets divide into smaller segments where the purchasers have similar characteristics and tastes. Consumers within market segments are identified as having similar characteristics. eg. commercial and domestic (furniture) Could also include: **-Geographic Segmentation**: Country, climate (temperature and humidity range), environment, location, area that product will be used/sold **-Psychographic Segmentation**: Users specific needs such as attitudes, behaviour and values. Is it about educating people, empowering society, changing attitude of people (could include the UWC mission statement) e.g. eco-fans **-Demographic Segmentation**: Average age range of user, skill level, gender, income, lifestyle, profession, family, etc.n
Product Family	A group of products having common classification criteria. Members normally have many common parts and assemblies. Some companies manufacture a group of related goods or services, they are often grouped together under the title of a 'product family'. e.g. Apple products (iPhone 6 has 2 sizes), BMW cars, Kenwood household products, Dyson products. Product family encourages consumers to purchase other products in the range if they have had a positive experience with the brand. A product family is a group of products that have a common classification criteria. Members of a product family normally have many common parts and assemblies, are branded consistently and share aesthetic characteristics. Designers often develop product families to extend a successful product range and to develop products for market segments that are already familiar with the original product. E.g. iPhone, iPad, iTouch

Notes:

9.3 Marketing Mix

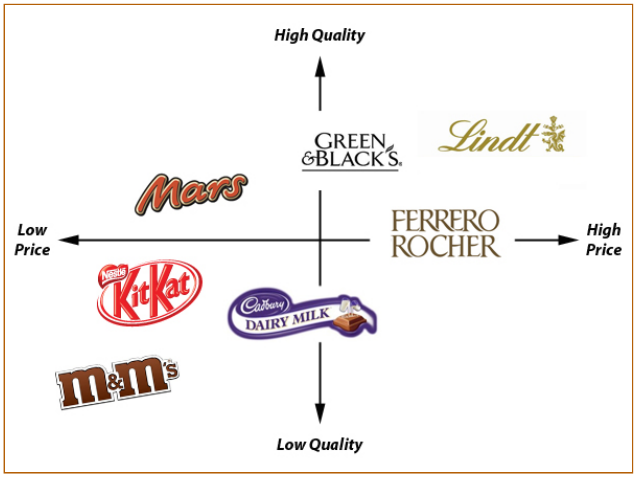
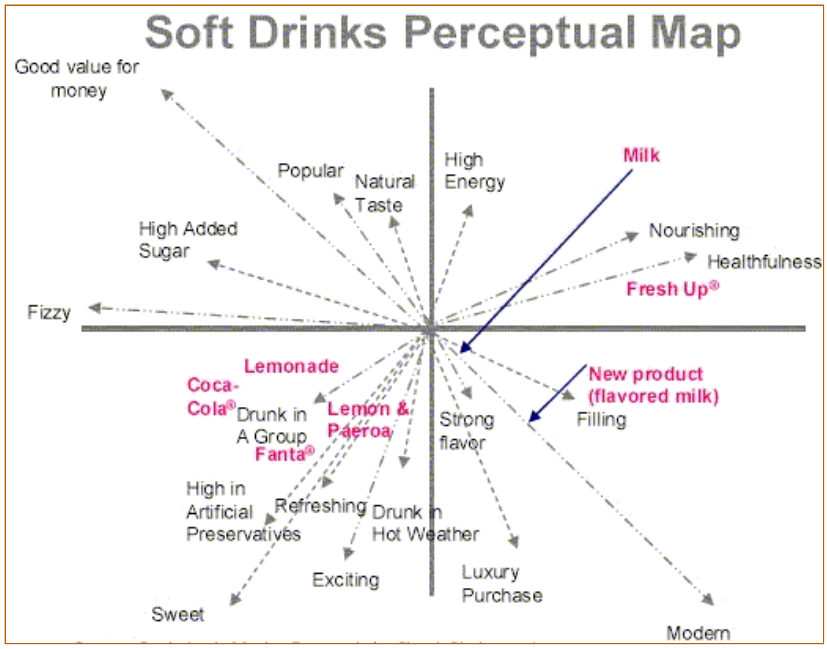
Empathy for, and understanding of the target audience is developed through thorough analysis of the market chosen. This informs several factors: the standards that end users demand; how and where to distribute and sell the product; how much they are willing to pay for a certain product and its quality; and how to communicate the launch of a product. Correct analysis of these factors could determine the success or failure of a product, despite its quality.

Marketing Mix- 4 P's	Four factors identified through market research that provide the designer with an accurate brief of market requirements. The 4 P's are: **-Product**: Variety, Quality, Design, Package and Brand **-Place**: Distribution, Delivery, Retail Locations, Download and Logistics **-Price**: Retail of product (see **Setting Price** below) **-Promotion**: The ways that can be used to communicate information about a product or system to consumers and other interested parties. Promotion strategies include "above the line" (mass advertising) and "below the line" (targeted advertising). Examples include Discount, Bonuses, Advertising, Personal Selling, Sales Promotion, Public Relations, Sponsorship, Sales Calls, Brochures, Emails, Payment Plans and Credit Terms
Why is a **marketing mix** important to specific target market groups?	Standards the end users demand; how and where the product will be used, how it will be distributed and sold and how much the consumer is willing to pay for a certain product and quality, and how the product will be communicated or launched. Correct analysis of these factors could determine the success and failure of a product, despite its quality.
Product Standardisation	State-based legislation to guarantee quality, safety and reduce potential risks for the user. Allow for interchangeability of components. Support globalisation.
Place: What are the **implications** of internet selling for a company in relation to its supply chain and distribution network ?	Overheads (rent, capital, land) are reduced. Companies will only carry little stock and place orders through suppliers on a needs only basis.
Setting Price	There are 4 types of pricing strategies: demand, competitor-based, product line, and psychological pricing. **Demand pricing:** Where the different products from the same product range are positioned at different price points. A pricing strategy where a company will set the price based on the demand for the product. Could be set by how much a customer values the product (Rarity, scarcity and prestigious branding contribute to higher pricing) **Competitor pricing:** Monitoring competitor's pricing, and offering lower prices to increase demand **Product line pricing:** The offering of add ons to improve or vary the product maximises profits by increasing sales. **Psychological pricing:** Where a product is priced to give the impression that it is paying less. For example, pricing at €1.99 instead of €2 i.e. making a price look better. **Cost-plus strategy:** A pricing strategy where a company will add a percentage to the total costs incurred for a product (production, design, distribution etc.)
Competition-based pricing strategy	A pricing strategy where a product is positioned in the market based on the price of similar products/competitors. The company will position the product by pricing it lower, similar or higher than similar products.
What is the **purpose of promotion**?	The ways that can be used to communicate information about a product or system to consumers and other interested parties. Encouraging consumer to make a positive buying choice. Raise product awareness to increase sales

9.4 Marketing Research

Market research is any organized effort to gather information about markets or customers. Market research often identifies how to improve the product, service or system and increase its chance of success within a particular sector or segment. The price a user is prepared to pay is usually determined through market research. This in turn sets an upper limit of cost to the design and production of a potential product, service or system. Market research has a crucial role in determining the constraints a designer has to work within.

Purpose of **market research**	The purpose of market research includes idea generation and development; evaluating market potential and economic trends; collecting data relating to demographics, family roles, consumers; identifying suitable promotional strategies; considering technological trends and scientific advances
Market research **strategies**	Market research is the systematic gathering of data about individuals or organisations using statistical analysis and techniques to support decision making. Strategies include literature search, expert appraisal, user trial, user research, perceptual mapping and environmental scanning. Advantages: information comes authoritative sources Disadvantages: early markets are volatile and unpredictable, unreliable for innovative products
Primary data collection	Data observed or collected directly from first-hand experience. Large Scale Primary data collection can be very costly but vitally important and more accurate than secondary data.
Secondary data collection	Published data and the data collected in the past or by other parties. Secondary data can be very valuable especially in terms of demographics, ergonomics and overall market analysis.
Qualitative	Data that is personal to individuals e.g. comfort, taste, etc.
Quantitative	Data with numbers/statistics
Literature search	The use of consumer reports, newspaper, magazines, encyclopaedias, manufacturers information, etc to conduct research and follow historical development. Useful sources of information could include internet, DVD, Encyclopedia, newspaper, Which UK Consumer website, manufacturers information and specification of products.
Expert appraisal	The reliance on the knowledge and skills of an expert in the operation of the product. Can be bias and also sometimes difficult to locate an expert.
User trial	The observation of people using a product and collection of comments from people who have used a product. Is done in a laboratory, usually with hidden cameras or data loggers which record the interaction between the user and product. Is useful to identify usability issues but can be expensive to run.
User research	Obtaining users' responses through questionnaires/surveys and interviews. Involves the questioning of users regarding their experiences and opinions of a product. Methods typically include questionnaire, user diaries, interviews and focus groups. It is generally easy to collect data and relatively cheap.

Perceptual mapping	Perceptual mapping is a tool to quickly compare a product to others in the market in a graphical representation. This graphic marketing tool is used to show how something is regarded, understood or interpreted, by identifying the relationships between competing products, buying choices and future recommendations by consumers. Typically the position of a product, product line,or brand, of a company is displayed relative to their competition. An example shown below:  
Environmental scanning	Environmental scanning is the study and interpretation of the political, economic, social and technological events and trends which influence a business, an industry or even a total market.
Consumers' reaction to **technology**	**-Technophiles** is someone who immediately **welcomes** a technological change. Early adopters of technology. Prepared to pay premium for early entry into the market just to acquire the product. **-Technophobe** is someone who **resists** all technological change. Not comfortable with new ways of working and often subscribe to the theory that what they currently have is enough for their needs. **-Technocautious** is someone who needs **some convincing** before embracing technological change. Tend to wait for improvements in technology. They may not feel comfortable with new ways of working, and often remain with what's existing.

Consumers' reaction **green design**	-**Eco-warriors** actively demonstrate on environmental issues (Greenpeace). Care for the natural world in their daily lives and decision-making. -**Eco-fans** enthusiastically adopt environmentally friendly practices as consumers.Seek to help others in applying these same principles. Aim to spread the practice of environmentally friendly consumption and lifestyle. -**Eco-champions** are influential people that can use their position to influence certain issues within an organisation (often artists, movie stars, etc.) -**Eco-phobes** actively resent talk of environment protection. Objectify the environment and see it as a machine that produces resources and energy for the use and control of mankind. Champion technological solutions to problems, see environmental protection as an inefficiency that only increases company costs, causes delays and reduces profitability.
Market research strategies	Advantages and disadvantages of each market research strategy considering the nature, reliability and cost of the research and importance to the design development process. Some strategies include: - Expert appraisal - User Trial - Consumer Surveys - Patent investigations - Literature scanning - Competition or SWOT analyses New product development involves manufacturers exploring the needs of the market and developing appropriate products in response. Market research, data and analysis by manufacturers that may involve: - Competitor Product Analysis - User trials to test product acceptance - "What-if" scenarios evaluating product profitability - Investigation of unfilled or alternative niche opportunities - Market dynamic analysis - User surveys and interviews focusing is on customer buying habits and attitudes - Targeting existing customers to gather their views on an existing product to seek ways of improvement.

9.5 Branding

In order to diffuse products into the marketplace, the identity of a company is typically embodied in a brand. The brand is communicated to the consumer through a value proposition. Designers help to communicate this by: building a strong user experience around the brand identity; determining content design; establishing the tone of message through advertisements and promotion. Branding creates an identity for a product or company, which makes it distinct from another and can provide added value.

Brand	A brand is a type of product manufactured by a particular company under a particular name. The company name of the organization can also serve as a brand. E.g. Lego, Nestle, Dyson, Apple
Brand loyalty	When a person has the tendency to favour one supplier over others for the same product. For example people who just tend to stick with Apple products- not even look at/consider alternative choices.
How brands **appeal to different market segments**	They identify the traits of specific market segments hence being able to precisely meet the needs of the identified group. e.g. Muji stores (Minimalist style- so segment is dictated by fashion style Prada, Louis Vuitton (Veblen Goods to show high social class)
The difference between a **trademark** and **registered design/patent**	**™-Trademark** or **Registered Design ®** - A trademark is a logo, symbol, word, or words legally registered or established by use as representing a company or product. e.g. Nike swoosh logo, apple logo, 'Just do it' **Patent**: Intellectual property mark that protects a **product's appearance or it's technology.** This refers to the features of the **product's** shape, configuration, pattern or ornamentation which is new and distinctive. The exclusive rights granted to a patentee in most countries (not all) is the right to prevent others from making, using, selling, or distributing the patented invention/imitating the appearance/technology of the product without permission.
The implications for a company of **positive and negative publicity on brand image**	Positive or negative publicity from one product can have an impact on the whole brand. If one product does badly, consumers may have a bad impression of the brand. This will discourage consumers from purchasing from this brand in the future. **Negative impact-** Clive Sinclair: even though their computer manufacturing was successful, they invented a new personal transport solution and it was poorly conceived. Due to that, lead to a massive decline in sales of all sinclair products. **Positive impact-** Virgin Atlantic : Richard Branson's activities have helped to provide positive perceptions of the company.
Contribution of packaging to brand identity	Packaging can have a big impact on brand identity . The final visible packaging to the customer of the product must align with the brand's ethos and support brand identity.
Evaluating the **global impact of branding**	Apple, Adidas, Starbucks, Nike, Toyota, etc. Provides a sense of belonging to a global community. Maybe even a cult/fashion/trend/lifestyle. The product brand will become associated with success and quality.

updated 22nd Feb 2016- J. Zobrist

Examples of Questions

1. The marketing mix or 4Ps is composed of

A. planning, preparation, policy, particulars
B. product, price, place, promotion
C. presentation, permanence, placement, price
D. propaganda, percentiles, producing, price.

2. Psychological pricing engenders

A. use of all five senses
B. a physiological response
C. price perception on the consumer's part
D. price exaggeration on the consumer's part.

3. Market research is conducted to

A. reduce waste
B. check the success of a product
C. meet manufacturing requirements
D. best match product development with consumer needs

4. Brand loyalty is best expressed when

A. consumers purchase only brand name products
B. consumers speak positively about a product to others
C. consumers accrue points based on brand purchases
D. consumers continue to make purchasing decisions based on a brand name irrespective of price.

5. Discuss the advantages and disadvantages associated with corporate responsibility programs. **(4 marks)**

Advantages:
- *Improves company image in the market*
- *Creates ethically and environmentally considerate corporations - therefore beneficial to society*
- *Provides a distinction for consumers away from company's major business area*
- *Increase transparency, accountability - better customer relations - Brand loyalty*

Disadvantages:
- *Could be expensive/take excess time/resources to complete these programmes*
- *They may in completed in vain and be a sole tool of marketing to promote a company, rather have any real impact*

6. Explain the use and purpose of perceptual maps in marketing. **(2 marks)**

Perceptual maps serve as a visual representation of the sectors in a market in order to create a marketing strategy that has a competitive edge. Allows for market diversification, and innovation to generate more interest/profit

It is a tool to quickly compare a product to other markets in a graphical representation where they can view their position in the market and change accordingly/allows designers to analyze consumer purchases trends.

7. Explain the differences between product development and product diversification. **(4 marks)**

Product Development is the iterative process of improving a product based on aspects such as market research, changes in trends and more. Product development involves the introduction of a new product into a market or the improvement of existing ones.

Product diversification is the expansion of a product family/ company's product range to appeal to a larger market audience. Product diversification involves the modification of an existing product so that its market potential can increase. For example, Apple making 2 screen sizes for the iPhone.

8. Explain why companies adopt an imitation strategy rather than developing new products of their own. **(2 marks)**

Saves money on research and development and also the reduction with design and development time hence lowers overall cost which leads to a possible higher profit.

9. Explain how companies may brand similar products to meet different market segments. **(4 marks)**

- *Have a unique branding strategy so that they can appeal to different market groups and attract existing market groups to innovative ideas.*
- *Create different sets of product families to appeal to different parts of the market, such as iWatch Edition and other i watch ranges to appeal to those with different styles/socioeconomic abilities and more*
- *Can lead to product diversification as same brand is able to be recognised by a larger audience due to its product diversification*
- *They identify the traits of specific market segments, hence being able to precisely meet the needs of the identified group. Richard Branson diversifies his company to produce not only in the airline industry but also food, railway, etc.*

10. Compare and contrast the activities of marketing and advertising. **(4 marks)**

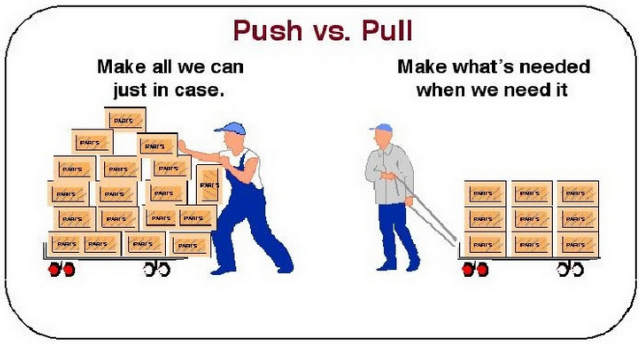
Advertising is the interaction between the products and the consumer, and understanding how to best place products in order to increase sales by engaging with the consumer in a certain way.

Marketing encompasses advertising, however it is more about the brand strategy, and commercial development of the company as a whole, rather than specific products.

Topic 10
Commercial Production

10.1 Just in Time & Just in Case

Just in time and just in case are opposing production strategies utilized by the manufacturer. While inventory creates a safety net for companies, maintenance and potential waste of resources can have significant implications for companies and the environment. Manufacturers must evaluate and analyse each market and determine whether a JIT or JIC strategy is the best to follow.

<table>
<tr><td>Just in time (JIT) and just in case (JIC)</td><td>JIT and JIC are two production strategies used by manufacturers that have both advantages and disadvantages to them. A manufacturing company will choose one of these strategies to follow for many reasons that include the products they are producing, the nature of the market and the nature of the economy.
 
</td></tr>
<tr><td>Just in time (JIT)</td><td>A situation where a company does not allocate space to the storage of components or completed items, but instead orders or manufactures them when required. Large storage areas are not needed and items that are not ordered by customers are not made.

<table>
<tr><th>Advantages of JIT</th><th>Disadvantages of JIT</th></tr>
<tr><td>-Production to order with materials being supplied JIT cuts down on storage space
-Reduced capital investment as capital is not tied up in unused raw materials or unsold products.
-Reduced work in progress
-Increased efficiency
-Improved stock control</td><td>-If any of the stock is faulty then more has to be ordered from a supplier which could slow down the lead time and production process.
-Companies may not benefit for economies of scale if they are purchasing smaller quantities.</td></tr>
</table></td></tr>
<tr><td>Just in case (JIC)</td><td>A situation where a company keeps a small stock of components or products or ones that take a long time to make, just in case of a rush order.

<table>
<tr><th>Advantages of JIC</th><th>Disadvantages of JIC</th></tr>
<tr><td>-Prevention of waste and overproduction
-Overheads are lower as warehouse space and inventories are less
-Every customer becomes a sale
-The manufacturer has a “buffer’ of goods in stock in case of unforeseen circumstances; e.g. non delivery of supplies
-The manufacturer can respond quickly to a demand for a product</td><td>- Shop owners have to hold a lot of inventory
- A large investment at the start of business
- It occupies a lot of space, which can be expensive
- These products might spoil leading to waste
- If trends change you could be left with</td></tr>
</table></td></tr>
</table>

	-The manufacturer can produce a steady flow of product and have a stable workforce -Less capital costs than JIT e.g. information and communication technology systems, stock control systems. -Able to stock pile supplies or finished products.	a lot of unsellable products

Notes:

10.2 Lean production

Lean production aims to eliminate waste and maximize the value of a product based on the perspective of the consumer. Lean production considers product and process design as an ongoing activity and not a one-off task, and should be viewed as a long-term strategy.

Lean production	Lean production considers product and process design as an ongoing activity and not a one-off task. It should be viewed as a long-term strategy that focuses on continual feedback and incremental improvement.
The characteristics of lean production include:	**1 - JIT supplies:** Getting the right amount of material to the production line Just In Time. **2 - Highly trained multi-skilled workforce:** Having experts in place to ensure that no time is wasted. **3 - Quality control and continuous improvement:** Checks are made at every stage of production to quickly identify and fix any problems that arise. Improvements to the system are actively sought. **4 - Zero defects:** Ensure that time, material and energy are not wasting producing a sub-standard product. **5 - Zero inventory:** Products are manufactured Just In Time to be sold.
10 principles of lean production.	1. Eliminating waste 2. Minimizing inventory 3. Maximizing flow 4. Pulling production from customer demand 5. Meeting customer requirements 6. Doing it right first time 7. Empowering workers 8. Designing for rapid changeover 9. Partnering with suppliers 10. Creating a culture of continuous improvement (Kaizen)
Kaizen	A **culture of continuous improvement** originating in Japan and considered an important aspect of an organization's long-term strategy. It is a philosophy and commitment to continuous process and product improvement.
Value stream mapping	Value stream mapping, also known as **'end-to-end'** is a visual aid to map relationship **between materials, processes, information and time**. It allows company managers to plan the manufacture of a product from start (purchase of raw materials) to manufacture (processes and systems) to distribution (export, to warehouse) and finally to the end (sale to customer). It is used to identify potential problems in the system. This 'big picture' view provides production managers with the necessary overview to plan where they can make improvements to the process in order to speed it up. It can also be used as a tool used to analyse current and future processes for the production of a product through to delivery to the consumer.
Workflow analysis	Workflow analysis supports value stream mapping as it **classifies all tasks in a manufacturing process.** It is the review by production managers of processes in a workflow, in order to identify potential improvements. Workflow analysis considers the sequence, tools and even worker movement to ensure the highest possible efficiency in the system.
Consider how **value stream mapping** and **workflow analysis** contribute to an effective lean production method.	Where **value stream mapping** provides a 'big picture' of the manufacturing process, **workflow analysis** is concerned with the details of the production line.

Role of the workforce	The role of the workforce in lean production must focus on these three areas; ▪ Training ▪ Devolution in power relating to process improvement ▪ Kaizen The development of a highly skilled workforce can build deep understanding of how the production process works and allow workers at all levels to identify areas of the workflow to be improved. Understanding that the best people to identify improvements of a product or system are those who use it, companies striving for a lean production system ensure that all members of the workforce are able to contribute to the design of the system. This benefits the company, which is able to streamline processes and reduce costs and also empowers the workforce and gives them a sense of ownership and loyalty to the company.
Kanban	Kanban is a way of managing knowledge (and or in this case stock, orders and quality). One way in which Kanban is used if for parts bins. When the parts bin reaches a low level (for example 20 left) the Kanban label is submitted to the accounts department to automatically order and deliver another batch of parts just in time.
Product Family	In terms of lean production, a **product family** is a group of products using similar processing methods. **E.g.** CNC machining for Apple laptop and iMac screen and keyboards all from aluminium. The concept of standardised specifications or components or assemblies within a product family or associated brands allows companies to create a competitive advantage. Often based around 'product platform' or 'standardised architecture' a product family gives the manufacturer the opportunity to produce customised or alternative designs through the addition, subtraction or substitution or parts. Advantages of a product family include: • Increased modularity • Reduced design effort • Reduced time to market for products • Less manufacturing processes • Reduction of the number of suppliers needed • Less diversity of stock material • Waste from one product can be used to manufacture a different product • Easily adapt production to meet demand for a particular family member
Lead time	The time between the initiation and the execution of a process. The time quoted to customers (usually in days or weeks) between the date of purchase and the date of delivery of final product. **Lead time= sum of all processes + sum of all delays (queue times between processes)**
The 5Ss is a formal approach to cleaning and organizing the workplace involving five processes:	1. sorting 2. stabilizing 3. shining 4. standardizing 5. sustaining the practice.
The **seven** wastes are:	1. overproduction 2. waiting 3. transporting 4. inappropriate processing 5. unnecessary inventory 6. unnecessary/excess motion 7. defects.

Advantages and disadvantages of Lean production

Advantages of Lean Production	Disadvantages of Lean Production
▪Minimises waste (and therefore reduces cost) ▪Less impact on the environment ▪Quickly adaptable to market pushes ▪Little capital is tied up in raw material or unsold stock ▪Increased autonomy for workers - leading to higher moral	▪One problem in production stops the whole process ▪Manufacturers rely on suppliers, one mistake by them halts production ▪More suitable for large scale production ▪When a certain level of refinement is met, using lean methods to squeeze more economy from production can discourage workers, reversing positive motivation and undermining your leadership.

Notes:

10.3 Computer integrated manufacturing (CIM)

Computer-integrated manufacturing uses computers to automatically monitor and control the entire production of a product. When considering design for manufacture (DfM), designers should be able to integrate computers from the earliest stage of design. This requires knowledge and experience of the manufacturing processes available to ensure integration is efficient and effective. Through the integration of computers the rate of production can be increased and errors in manufacturing can be reduced or eliminated, although the main advantage is the ability to create automated manufacturing processes.

<table>
<tr><td>Computer-integrated manufacture (CIM)</td><td>CIM is a system of manufacturing that uses computers to integrate the processing of production, business and manufacturing in order to create more efficient production lines. CIM systems can monitor all operations from raw materials intake to final product marketing.

Integrating computers facilitates sharing of data to create a more flexible and efficient manufacturing system.

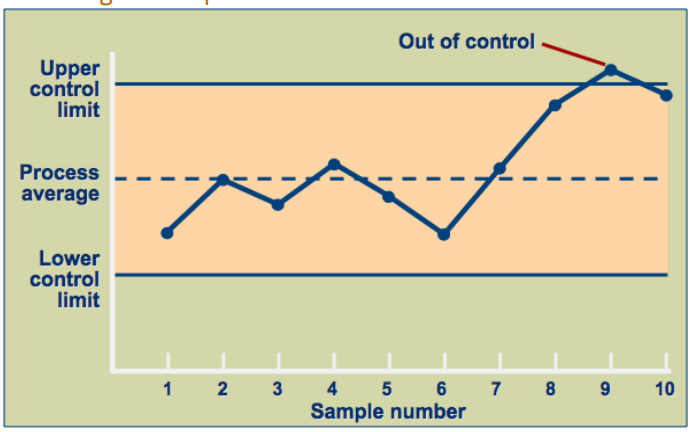
Computer- integrated manufacture (CIM) takes the concept of integration of separate manufacturing technologies and combines these with all aspects of a company's operations, not just those that are directly involved in manufacture. Under a CIM system, all teams can share the same information and easily communicate with one another.

A CIM system uses computer networks to integrate the processing of production and business information with manufacturing operations to create cooperative and efficient running production lines. CIM systems control and link the following components

The tasks performed within CIM will include:
• Personnel
• Marketing
• Product Design (CAD)
• Computer Management (Materials handling, planning, manufacturing
• Machine tools and Equipment (CAM)
• Purchasing (cost accounting)
• Distribution (inventory control)</td></tr>
<tr><td>When considering the advantages and disadvantages of CIM</td><td><table><tr><th>Advantages of CIM</th><th>Disadvantages of CIM</th></tr><tr><td>▪Complex products on large scale production runs are efficiently manufactured
▪Very flexible system as it is easy to set the automation
▪Suitable for batch production where repetitive patterns or operations occur.
▪Relatively low maintenance</td><td>▪High Investment
▪Smaller plants employing non-repetitive, specialised manufacturing operations have found less use for CIM</td></tr></table></td></tr>
<tr><td>CIM can be applied to different scales of production.</td><td>Consider the advantages and disadvantages of CIM in relation to different production systems.</td></tr>
<tr><td>Flexible manufacturing system (FMS)</td><td>A flexible manufacturing system (FMS) is a manufacturing system in which there is some amount of flexibility that allows the system to react in case of changes, whether predicted or unpredicted. This flexibility is generally considered to fall into two categories, which both contain numerous subcategories. Benefits of using a flexible manufacturing system (FMS)
- increased productivity due to automation
- shorter lead times for new products due to flexibility
- lower labour costs due to automation
- improved production quality due to automation</td></tr>
</table>

10.4 Quality management

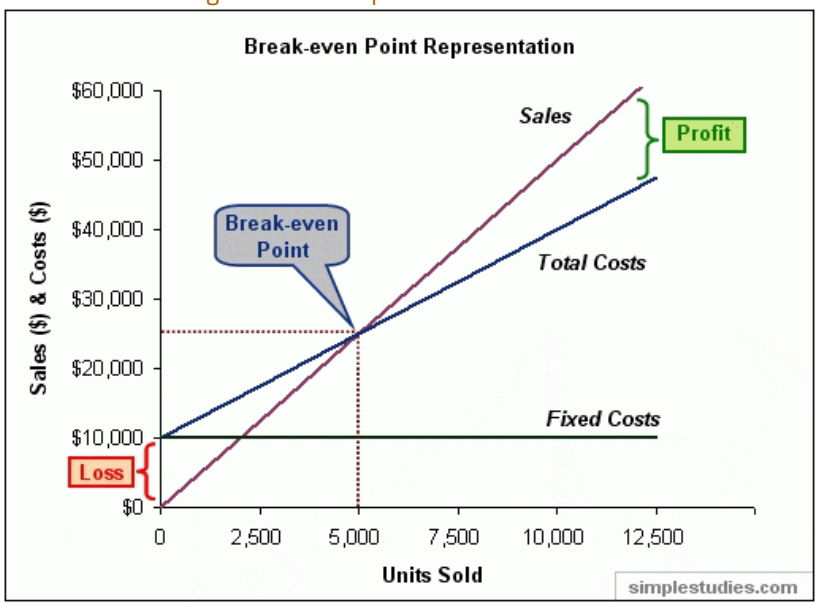
Quality management focuses on producing products of consistent required quality. Designers should ensure that the quality of products is consistent through development of detailed manufacturing requirements. They also need to focus on the means to achieve it. The importance of quality management through quality control (QC), statistical process control (SPC) and quality assurance (QA) reduces the potential waste of resources.

Quality control	Involved in development systems to ensure that products or services are designed and produced to **meet or exceed customer requirements and expectations.** Tolerances are defined at the design stage of the machinery. Parts not within tolerance need to be reworked or scrapped. Continuous monitoring ensures that the machines perform to the predetermined standard to produce quality product. Quality control at the source **eliminates** waste from defects as workers are responsible for the quality of the work they do.
Statistical process control	**SPC is applied in order to monitor and control a process.** This is a quality control tool that uses statistical methods to ensure that a process operates at its most efficient (within defined fields). This is achieved through measuring aspects of a component to ensure that it meets the required standard throughout its production in order to eliminate waste.   **E.g.** At the beginning of a process it is a waste of time and money to begin production process with bad supplies before a costly or irreversible point, after which the product is difficult to rework or correct before and after assembly or painting operations that might cover defects before the outgoing final product or service is delivered. **By monitoring the various parts of a process, stages are highlighted and the can be adjusted in order to maintain conformity and quality of output** and reduce costs, improve productivity, real-time decisions, reduce product variability and scrap, uncovers hidden process abnormalities which improves reaction times to process the changes needed.
Quality assurance.	This **covers all activities** from design to documentation. It also includes the regulation of quality of raw materials, assemblies, products and components, services related to production, and management and inspection processes.
Differences between QA vs **QC**	QA is **process** oriented while QC is **product** oriented. QA deals in developing processes and systems that align with **QMS**. QC on the other hand deals with monitoring products. **E.g.** a QA engineer would develop a quality plan based on customer requirements and a QC engineer would monitor and ensure that all requirements of the quality plan are met during manufacturing. A QA engineer may be involved in developing packaging & shipping requirements or provide quality specifications to purchasing. The QC engineer would only focus on making sure product meets the requirements of quality plan as set by QA. QA is the part of QM focussed on providing confidence that quality requirements will be fulfilled QC is the part of QM focussed on fulfilling quality requirements

10.5 Economic viability

Designers must consider the economic viability of their designs for them to gain a place in the market. Designers need to consider how the costs of materials, manufacturing processes, scale of production and labour contribute to the retail cost of a product. Strategies for minimizing these costs at the design stage are most effective to ensure that a product is affordable and can gain a financial return.

Cost effectiveness.	Is the most efficient way of designing and producing a product from the manufacturer's point of view.
Value for money	Is the relationship between what a product is worth and what it costs. It is important to note the difference between cost and price. For a product to achieve profit, the price of a product has to be higher than its cost. Costs include fixed and variable costs involved in designing and manufacturing the product, and getting it to the point of sale.
Costing vs. pricing	Price is how much consumers are willing and able to pay for certain goods and services. Cost is how much it takes to produce goods and services.
Fixed costs	Are the costs that must be paid out before production starts, for example, machinery. These costs do not change with the level of production. Fixed costs include all the costs that must be paid out before production starts; e.g. design costs, set up/tooling costs, marketing; initial set-up/tooling costs will be high for first model but may be able to use same tooling and thus reduce costs for subsequent models; design for manufacture will reduce fixed costs; R & D fixed costs will be very high in order to develop new products regularly;
Variable costs	Fixed costs are the costs that must be paid out before production starts. Are **costs that vary with output**, for example, fuel or raw material. Variable costs include all the costs that vary with the volume of production; e.g. materials, energy; lightweighting will reduce amount of material required and could reduce variable costs; variable labour costs can be reduced by setting up manufacturing in countries with relatively cheap labour;
Cost analysis	Cost Analysis **involves the examination and evaluation of the separate elements of cost including profit.** It is a tool used to determine the potential risks and gains of producing a product. It is used by manufacturers to determine the break-even point for a product and can be used to create multiple scenarios for a product. It allows the feasibility of a product to be established. Can also be separated into: -**Financial Cost Analysis:** Analyses how a financial decision will impact an individual or single company. -**Economic Cost Analysis:** Analysis the impact of a financial decision on the economy as a whole including the environment and society.

Break-even or **Break-even point**	Is the point of balance between profit and loss. It represents the number of sales of a product required to cover the total costs (fixed and variable). Average revenue and average total cost equals to each other.  Break-even point: the number of products that will be made to recoup the set-up costs; a proportion of the fixed costs will be recouped on each product; after the break-even point the profits of the manufacturer will increase; alternatively the manufacturer can drop the price to enhance the competitiveness of the product once fixed costs are covered; the manufacturer determines
Pricing setting strategies: (from T9.3)	**Demand Pricing:** Where the different products from the same product range are positioned at different price points. A pricing strategy where a company will set the price based on the demand for the product. Could be set by how much a customer values the product (Rarity, scarcity and prestigious branding contribute to higher pricing). **Competitor pricing:** Monitoring competitor's pricing, and offering lower prices to increase demand **Product line pricing:** The offering of add ons to improve or vary the product maximises profits by increasing sales. **Psychological pricing:** Where a product is priced to give the impression that it is paying less. For example, pricing at €1.99 instead of €2 i.e. making a price look better. **Cost-plus strategy:** A pricing strategy where a company will add a percentage to the total costs incurred for a product (production, design, distribution etc.) **Competition-based pricing;** A pricing strategy where a product is positioned in the market based on the price of similar products/competitors. The company will position the product by pricing it lower, similar or higher than similar products.
Price-minus strategy	The **opposite (retail minus)** of cost-plus pricing strategy. The manufacturer will conduct user research to determine how much consumers are willing and able to pay for certain goods and services. Once companies have this information, they minus the profit margin to determine the price and work out how to produce it at that price point.

Retail price	The price at which a product is sold in a store. This price is usually double the wholesale price. E.g. Nike T-shirt costs $49.99 in a World of Sports store. Usually RRP (Recommended Retail Price)
Wholesale price	The price at which a good is sold to a retailer. This price is greater than what the wholesaler paid the producer but less than the price at which the retailer will sell in a store. E.g. World of Sports paid $24.99 for that Nike shirt before selling it at a retail price of $49.99.
Typical manufacturing price	The price required to manufacture a product. This is cheaper than the price it is sold to a wholesaler or retailer. E.g. It costed Nike $20 to manufacture that Nike shirt before selling it to a wholesaler at $24.99.
Target costs	A target cost is a marketing approach that assigns an appropriate price to a product prior to its production or manufacture. Target costing is to enable management to manage the business to be profitable in a very competitive marketplace. In effect, target costing is a proactive cost planning, cost management, and cost reduction practice whereby costs are planned and managed out of a product and business early in the design and development cycle, rather than during the later stages of product development and production.
Unit cost	$\frac{\text{Total cost (production cost)}}{\text{Total output (how many products are made)}}$ = average cost (based on one product)
Return on investment	Compares a **company's profitability** with a company's efficiency and is often **expressed as a percentage** of the net profits, divided by the cost of investment. $\text{ROI} = \frac{\text{Total Revenue - Total Cost}}{\text{Total Cost}} \times 100$
Financial return	Financial return is the profit gained from an investment for **the product** (investment in plant, staffing, materials, marketing and associated costs surrounding the manufacture and sale). Expressed in $$$ for the profit of buying and selling stocks.
Sales volume	The number of quantity of goods or services sold/provided over a particular period of time