**MODULE E**

**D4S RULES OF THUMB**

1> **SELECTION OF LOW-ImpACT MATERIALS**

a> Cleaner materials
1. Do not use materials or additives which are prohibited due to their toxicity. These include PCBs (polychlorinated biphenyls), PCTs (polychlorinated terphenyls), lead (in PVC, electronics, dyes and batteries), cadmium (in dyes and batteries) and mercury (in thermometers, switches, fluorescent tubes).

2. Avoid materials and additives that deplete the ozone layer such as chlorine, fluorine, bromine, methyl bromide, halons and aerosols, foams, refrigerants and solvents that contain CFCs.

3. Avoid the use of summer smog-causing hydrocarbons.

4. Find alternatives for surface treatment techniques such as hot-dip galvanization, electrolytic zinc plating and electrolytic chromium plating.

5. Find alternatives for non-ferrous metals such as copper, zinc, brass, chromium and nickel because of the harmful emissions that occur during their production.

b> Renewable materials
6. Find alternatives for exhaustible materials.

c> Lower energy content materials
7. Avoid energy-intensive materials such as aluminum in products with a short lifetime.

8. Avoid raw materials produced from intensive agriculture.

d> Recycled materials
9. Use recycled materials wherever possible, to increase the market demand for recycled materials.

10. Use secondary metals such as secondary aluminum and copper instead of their virgin (primary) equivalents.

11. Use recycled plastics for the inner parts of products which have only a supportive function and do not require a high mechanical, hygienic or tolerance quality.

12. When hygiene is important (as in coffee cups and some packaging) a laminate can be applied, the centre of which is made from recycled plastic, covered with or surrounded by virgin plastic.

13. Make use of the unique features (such as variations in colour and texture) of recycled materials in the design process.

e> Recyclable materials
14. Select just one type of material for the product as a whole and for the various sub-assemblies.

15. Where this is not possible, select mutually compatible materials.

16. Avoid materials which are difficult to separate such as compound materials, laminates, fillers, fire retardants and fiberglass reinforcements.

17. Preferably use recyclable materials for which a market already exists.

18. Avoid the use of polluting elements such as stickers which interfere with recycling.
f. Materials with positive social impact, i.e., by generating local income
19. Make use of materials supplied by local producers.
20. Stimulate arrangements for recycling of materials by local companies which can substitute (part of) the raw materials of the company.

2. Reduction of Materials Usage

a. Reduction in weight
21. Aim for rigidity through construction techniques such as reinforcement ribs rather than ‘overdimensioning’ the product.
22. Aim to express quality through good design rather than over dimensioning the product.

b. Reduction in (transport) volume
23. Aim at reducing the amount of space required for transport and storage by decreasing the product’s size and total volume.
24. Make the product foldable and/or suitable for nesting.
25. Consider transporting the product in loose components that can be nested, leaving the final assembly up to a third party or even the end user.

3. Optimization of Production Techniques

a. Alternative production techniques
26. Preferably choose clean production techniques that require fewer harmful auxiliary substances or additives (for example, replace CFCs in the degreasing process and chlorinated bleaching agents).
27. Select production techniques which generate low emissions, such as bending instead of welding, joining instead of soldering.
28. Choose processes which make the most efficient use of materials, such as powder coating instead of spray painting.

b. Fewer production steps
29. Combine constituent functions in one component so that fewer production processes are required.
30. Preferably use materials that do not require additional surface treatment.

c. Lower/cleaner energy production
31. Motivate the production department and suppliers to make their production processes more energy efficient.
32. Encourage them to make use of renewable energy sources such as wind energy, water power and solar energy. Where possible, reduce the use of fossil fuels and reduce environmental impact by, for example, choosing low-sulphur coal or natural gas.

d. Less production waste
33. Design the product to minimize material waste, especially in processes such as sawing, turning, milling, pressing and punching.
34. Motivate the production department and suppliers to reduce waste and the percentage of rejects during production.
35. Recycle production residues within the company.

e. Fewer/cleaner production consumables
36. Reduce the production consumables required – for example, by designing the product so that during cutting waste is restricted to specific areas and cleaning is reduced.
37. Consult the production department and suppliers as to whether the efficiency with which operational materials are used during production can be increased – for example, by good housekeeping, closed production systems and in-house recycling.

f. Safety and cleanliness of the workplace
38. Choose production technologies that require fewer harmful substances and generate less toxic emissions.
39. Use production techniques that generate less wastes, and organize efficient in-company re-use and recycle systems for the remaining waste.
40. Implement systems for in-company working conditions, health and safety like SA8000.
4> OPTIMIZATION OF DISTRIBUTION SYSTEM

a> Less/cleaner/reusable packaging
41. If all or some of the packaging serve to give the product a certain appeal, use an attractive but lean design to achieve the same effect.
42. For transport and bulk packaging give consideration to reusable packaging in combination with a monetary deposit or return system.
43. Use appropriate materials for the kind of packaging – for example, avoid the use of PVC and aluminum in non-returnable packaging.
44. Use minimum volumes and weights of packaging.
45. Make sure the packaging is appropriate for the reduced volume, foldability and nesting of products – see strategy 2b.

b> Energy efficient transport mode
46. Motivate the sales department to avoid environmentally-harmful forms of transport.
47. Transport by container ship or train is preferable to transport by lorry.
48. Transport by air should be prevented where possible.

c> Energy efficient logistics
49. Motivate the sales department to work preferably with local suppliers in order to avoid long-distance transport.
50. Motivate the sales department to introduce efficient forms of distribution – for example, the simultaneous distribution of larger amounts of different goods.
51. Use standardized transport packaging and bulk packaging (Europallets and standard package module dimensions).

d> Involve local suppliers (distributed economies)
52. Explore options for contracting more local transport/distribution.
53. Form logistic consortia with fellow companies in the community to jointly outsource distribution and transport in an efficient way and by involving local distributors.

5> REDUCTION OF IMPACT DURING USE

a> Low energy consumption
54. Use the lowest energy consuming components available on the market.
55. Make use of a default power-down mode.
56. Ensure that clocks, stand-by functions and similar devices can be switched off by the user.
57. If energy is used to move the product, make the product as light as possible.
58. If energy is used for heating substances, make sure the relevant component is well insulated.

b> Clean energy source
59. Choose the least harmful source of energy.
60. Do not encourage the use of non-rechargeable batteries – for example, a portable radio can be supplied with a battery charger, encouraging the use of rechargeable batteries.
61. Encourage the use of clean energy such as low-sulphur energy sources (natural gas and lowsulphur coal), fermentation, wind energy, water power and solar energy. An example is a solar heater which does not require energy for heating water during the summer.

c> Fewer consumables needed
62. Design the product to minimize the use of auxiliary materials – for example, use a permanent filter in coffee makers instead of paper filters, and use the correct shape of filter to ensure optimal use of coffee.
63. Minimize leaks form machines which use high volumes of consumables by, for example, installing a leak detector.
64. Study the feasibility of reusing consumables – reusing water in the case of a dishwasher.

d> Cleaner consumables
65. Design the product to use the cleanest available consumables.
66. Make sure that using the product does not result in hidden but harmful wastes – for example, by installing proper filters.
e> Reduce wastage of energy and other consumables
67. Misuse of the product as a whole must be avoided by clear instructions and appropriate design.
68. Design the product so that the user cannot waste auxiliary materials – for example, a filling inlet must be made large enough to avoid spillage.
69. Use calibration marks on the product so that the user knows exactly how much auxiliary material, such as a washing powder, to use.
70. Make the default state that which is the most desirable from an environmental point of view – for example, ‘no cup provided by drinks dispenser’ or ‘double-sided copies’.

f> Health supporting, social added value
71. Make sure the product has zero or minimal impact on the health of the user by avoiding use of toxic substances, low radiation levels etc.
72. Design the product in accordance to the socio-economic needs and possibilities of the user groups.
73. Assess the opportunities to design products for low-income groups.

6> OPTIMIZATION OF INITIAL LIFETIME_

a> Reliability and durability
74. Develop a sound design and avoid weak links. Special methods such as the Failure Mode and Effect Analysis have been developed for this purpose.

b> Easier maintenance and repair
75. Design the product in such a way that it needs little maintenance.
76. Indicate on the product how it should be opened for cleaning or repair – for example, where to apply leverage with a screwdriver to open snap connections.
77. Indicate on the product itself which parts must be cleaned or maintained in a specific way – for example, by colour-coded lubricating points.
78. Indicate on the product which parts or sub-assemblies are to be inspected often, due to rapid wear.
79. Make the location of wear on the product detectable so that repair or replacement can take place on time.

80. Locate the parts which wear relatively quickly close to one another and within easy reach so that replacements are easy to dismantle for repair or replacement.

c> Modular product structure
81. Design the product in modules so that the product can be upgraded by adding new modules or functions at a later date for example, plugging in larger memory units in computers.
82. Design the product in modules so that technically or aesthetically outdated modules can be renewed. For example, make furniture with replaceable covers which can be removed, cleaned and eventually renewed.

d> Classic design
83. Design the product’s appearance so that it does not quickly become uninteresting, thus ensuring that the product’s aesthetic life is not shorter than its technical life.

e> Strong product-user relation
84. Design the product so that it more than meets the (possibly hidden) requirements of the user for a long time.
85. Ensure that maintaining and repairing the product becomes a pleasure rather than a duty.
86. Give the product an added value in terms of design and functionality so that the user will be reluctant to replace it.

f> Involve local maintenance and service systems
87. Design the product with the possibilities of local service and maintenance companies in mind.
88. Jointly develop new innovative service and repair centers in the region that can be involved both in servicing the new products and existing products.

7> OPTIMIZATION OF END-OF-LIFE SYSTEM_

a> Re-use of product
89. Give the product a classic design that makes it aesthetically pleasing and attractive to a second user.
90. Make sure that the construction is sound so that it does not become prematurely obsolete in the technical sense.
b> Remanufacturing/refurbishing
91. Design for dismantling (from product to sub-assemblies) to ensure easy accessibility of the product for inspection, cleaning, repair and replacement of vulnerable or innovation-sensitive sub-assemblies or parts.
92. The product should have a hierarchical and modular design structure; the modules can then each be detached and remanufactured in the most suitable way.
93. Use detachable joints such as snap, screw or bayonet joints instead of welded, glued or soldered connections.
94. Use standardized joints so that the product can be dismantled with a few universal tools – for example, use one type and size of screw.
95. Position joints so that the person responsible for dismantling the product does not need to turn it around or move it.
96. Indicate on the product how it should be opened non-destructively – for example, indicate where and how to apply leverage with a screwdriver to open snap connections.
97. Locate the parts that are relatively quickly worn out close to one another, so that they can be easily replaced.
98. Indicate on the product which parts must be cleaned or maintained in a specific way – for example, by using colour-coded lubricating points.

c> Recycling of materials
99. Give priority to primary recycling over secondary and tertiary recycling.
100. Design for disassembly (from sub-assemblies to parts).
101. Try to use recyclable materials for which a market already exists.
102. If toxic materials have to be used in the product, they should be concentrated in adjacent areas so that they can easily be detached.

d> Safer incineration
103. The more toxic materials there are in a product, the more the responsible party has to pay for its incineration. Toxic elements should therefore be concentrated and easily detachable so they can be removed, paid for and treated as a separate waste stream.

e> Taking in consideration local (informal) collection recycling systems
104. Assess the possibilities of existing formal or informal recycling activities in the community to be involved in the take-back and recycling of the product.
105. Jointly develop and/or support new and efficient collection and recycling systems in the region.