For the Readers of the Book "A HOLISTIC VIEW OF SOFTWARE AND HARDWARE REUSE "

Dear Reader:
Thank you for purchasing our book.

Following you find the answers to the exercises placed at the end of each chapter of the book. If you have questions and/or hints please write to

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PART I

Chapter I – Answers/Hints to Exercises

1. See Section 2
2. See the section "Prologue", especially the paragraph "Why is a Holistic View". And Section 2
3. See the answer to Question 2
4. Check Internet using the descriptors "hardware/software reuse" and "standards"
5. Check electrical, electronic and electro-mechanic devices around you
6. See Section 3.1
7. See Section 3.1.1
8. See Section 2 and combine its statement with Section 1.4
9. See Section 2.2
10. See Section 3.2.5
11. See Section 3.2.6
12. See Section 3.3.16
13. See Section 1.4 and Section 5.5
14. See Section 5.2
15. See Section 5.4
16. See Section 55.5 and compare with "Testing/Modeling-in-the-small vs. Testing/Modeling -in-the-large"
17. See Section 5.1
18. See introduction part of Section 1 at the beginning
19. See Section 5.5

Chapter II - Answers/Hints to Exercises

1. See Section 6.4 and Section 6.6 - component and system construction have to fit together.
2. See Section 6.2 and Section 6.3
3. See Section 6.6
4. See Section 6.5 and Prologue, Fig. 1
5. See Section 6.6 and Prologue, Fig. 1
6. See Section 7.1
7. See Section 8.1 and Section 8.2

Chapter III - Answers/Hints to Exercises

1. See Section 9.1, Term paper/Project work
2. See Section 9.2

3. See Section 10 and its sub-sections
4. See Section 11.1 and Section 11.2
5. See Section 11.2
6. 14, or more?
7. It starts with specific, implementation-oriented features to come to general ones.
8. No
9. Term paper/Project work
10. See Section 12
11. See Section 12.6
12. See Section 13
13. Term paper/Project work

Chapter IV - Answers/Hints to Exercises

1. See Section 3.1.1, Section 9.1.3; Term paper/Project work
2. See Section 11; Term paper/Project work
3. See Section 10.3, Term paper/Project work
4. Term paper/Project work
5. Term paper/Project work
6. Term paper/Project work
7. Term paper/Project work
8. Term paper/Project work
9. Term paper/Project work
10. See Section 14.2.2
11. See Section 16.2
12. See Section 16.3
13. Term paper/Project work
14. Term paper/Project work

Chapter V - Answers/Hints to Exercises

1. Variability and the number of the applications' features are multiplicative factors
2. See Section 18.3
3. Term paper/Project work
4. See Section 18.3 and Section 19, Term paper/Project work
5. Term paper/Project work
6. See Section 18.3
7. Term paper/Project work
8. Check the reference, Term paper/Project work
9. Term paper/Project work
10. See Section 20, Term paper/Project work

PART II

Chapter 6.1: Requirements for the Reuse of Hardware Components and Systems

Which components could be reused without further testing only after visual inspection? Use own experience. Please name some components and explain why you have selected them.

Answer: Such components might be metal parts without traces of abrasion, corrosion etc. Don´t take parts which could have been stressed.

Which environmental reasons could occur that components for example of a mobile phone should not be reused? Why is material recovery interesting for mobile phones? Mention some reasons.

Answer: Components might be no more up-to-date (memory to small, old fashioned…). If components are not reusable they may contain: gold, silver and other valuable metals.

How could an average of 5% reuse of components or products be achieved if the useful life of a product is 5 years and the sales of the same kind of new products ends after 6 years. Make some assumptions and discuss some possibilities.

Answer: Assumption: 20% of product put on the market per year, same value is returned. Then after 5 years 20% of the product will be available, but not completely for reuse (because of defects, not all products are taken back). But estimated the 5 % are reusable. Then only one year will beavailable for reuse in a new product because after 6 years production ends. Rest can be used only for repair. This shows a strategy is required for reuse components for several product generations.

Search in the internet about remanufacturing, reuse and read some case studies about successful reuse of products by companies. How many different industry branches do you find which apply already reuse/remanufacturing? Which ones concentrate on as-new components?

Answer: Nearly every industry applies reuse! Principles are different.

Mention some software problems that could occur with components after take back and before the components are newly integrated into a new product or system?

Answer: For example software of component was not updated. Too old components, do not fit to product software.

Will it be always sufficient to exchange the old software by the software of the latest state if a product or component is remanufactured? Explain some problems.

Answer: All systems have to fit together. The whole system has to be tested.

Chapter 6.2: Equivalent-to-new (ETN) and Qualified-as-Good-as-New (QAGAN) – More than Buzzwords Introduced by IEC 62309

What could be a real difference between absolutely new and the QAGAN state? Give some examples.

Answer: Scratches or slight discoloration doesn´t usually influence physical properties. The QUAGAN state concentrates to relevant properties.

Which problems could occur to name a complete reused product, not only components, to become QUAGAN?

Answer: Legal problems in a country. Testability.

Try to create a similar (and not really existing) system as in [5] for a cellular phone. Take the examples from [58] (to be downloaded from www.iameco.com) and explain what you would do to get a similar system.

Answer: Individual solution should have been found.

Chapter 6.3: Integrating Concept from Take Back to Disposal

The iameco PC has an NDL three times longer than for a conventional PC. Why could it not be dealt with like other products in Fig. 6.5?

Answer: It might be a problem that customers don´t return components in time. Age can be a problem.

How could a process look like if mainly wood is used and incineration of the material should not be the next step after take back?

Answer: Wood could be grinded and used for furniture or it could be used to generate chemicals. Both processes are not installed in industry.

How a manufacturer can save money if a cycle like in Fig. 6.6 is installed?

Answer: Components to be reused will be available for low cost or for free.

Chapter 6.4: Selection and Qualification of Components and Products for Reuse

Why are often only capital goods treated like the examples given and usually not consumer products although they are often sold in a much higher degree? Give some reasons.

Answer: Public take back systems are often not very effective. Products taken back are often in bad condition.

In which phases of take back till resale the SW state must be checked and what has to be documented for SW, after a product was sold to enable better take back at the end-of-life?

Answer: SW check should be done together with the test of the component. Before resale an update might be necessary. For every product the state of SW should be known. Updates and changes should be documented.

Chapter 6.5: Definition of New Product, Refurbished and Used Product

What does it mean about the legislation to be fulfilled if a product is as-new refurbished and should be resold? Mention some differences between a new product and a repaired used product, for example for legal requirements.

Answer: A repaired product will never be new. It could contain for example substances no longer be allowed in new products but for repair of old ones.

An as-new product will have the same properties as a new one. It will get the same guarantee level.

Define those requirements and standards which have to be applied to put the CE-mark on the product. When will it not be required to fix a CE mark on the product?

Answer: Safety and environmental properties are required. If the product was already put on the market and only exchanges were made a new CE mark is not required.

Chapter 7.1: Elements of Ecodesign

Why is a design strategy important?

Answer: Rules are often interconnected. Therefore a strategy for design is required.
Question: What has to be done first in design and in which steps?

Develop 5 very important rules for ecodesign from Table 7.1 and compare them with the quick 5 from Philips.

Answer: They should be similar.

Search the internet for companies with ecodesign rules? How many of them have rules for reuse or remanufacturing?

Answer: Bigger companies apply rules.

Search the internet for design strategies? How many different ones did you find? Can they be combined to one strategy or are there trade-offs?

Answer: Design strategies are rarely communicated. Trade-offs can happen between different design rules.

Which trade-offs do you see if certain materials should be avoided? What could happen if only renewable materials should be used?

Answer: Prices might increase. Compatibility for recycling might be different.

For example renewable plastics often cannot be recycled. The environmental benefit might be less than the use of plastics to be reusable several times.

Chapter 7.2: Green IT

Find out where your PC and your printer at home or in the office require too much time (and consume too much energy) or produce too much waste. Identify possibilities for improvement. What can you do? Which assistance may be offered by the manufacturer of a green IT product?

Answer: Own investigation

Why is the carbon footprint a quality criterion for SW?

Answer: It correlates to energy consumption.

How could a product working in a network like a production plant be made greener by IT? Give an example.

Answer: For example it could go to energy saving mode if not required.

Chapter 8: Recommendations for a Harmonic Interaction of HW and SW

Find out by means of the examples of the Energy Star (http;//www.spec.org/power/ and http://www.snia.org) where HW and SW need more cooperation.

Answer: Benchmarks allow finding out what causes too high energy consumption. If the HW is the same it must be caused by SW.

Which problems to the authors of the impact study do you see in this lot for HW and SW cooperation?

Answer: A repository of qualified SW should be built up. Otherwise unqualified SW will be reused and it is difficult later to identify the bad SW.

Chapter 9.1: Environmental Benefit of Reuse

Search the net for models with the target to extend the product lifetime. Find out where and how SW is integrated in these models.

Answer: Individual solution

Give some examples how older products or components could become energy saving after a SW takes control about its use.

Answer: For example a SW could switch off the HW instead of a continuously running HW component. Defects could be visualized. Print might be only on demand.

Chapter 9.1.2: Environmental Benefits

Search some trade-offs withstanding a remanufacturing of household equipment. How they could be overcome?

Answer: Household equipment may be very dirty or damaged. The equipment could be taken back directly from the customer if the new product is supplied. This is better than filling a public collection container. So, the danger of external damage or dirt will be lower.

Which benefit of reuse will be higher: Lifetime extension for example like by upgradeability, multiuse like by a product rental system or remanufacturing at the end of life? Make comparable assumptions for the products.

Answer: Lifetime extension can be a problem with too high energy consumption, as-new products often consume much less energy. Multiuse will end if customers feel the product becomes old-fashioned. Remanufacturing can lead to a nearly new product with low energy consumption.

Chapter 9.2: Quality testing - Examples/Case Studies, Evaluation of Components

Compare the standards in section 11.2. Where do you see problems with comparability, what should additionally be defined that you would trust the expertise and a certificate?

Answer: Comparison with a new state is the easiest way to compare. Other definitions might be possible but the legal and standardization requirements will afterwards become very complicated.

Would it be enough to fulfill only ISO 9001 and ISO 14001 to create a reused/remanufactured product of high quality?

Answer: No. Legal aspects have to be fulfilled. Requirements for special procedures such as for SW and HW in combination are missing.

Chapter 10.1: Reusability Organization

Draw a hierarchical connection through the tasks of the reusability organization (see Fig. 1.6 and 1.7). Which department might be responsible for these tasks?

Answer: Manufacturing department might become responsible because they define most of the requirements.

Chapter 10.2: Integration into Management Systems

Into which management system you would integrate SW reuse and integration. Describe which processes are required over the lifecycle to get a SW which fits afterwards to a QAGAN product.

Answer: ISO 9001 in development scheme.

By the Institute of validation (IVT) a standardization proposal was made as a white paper to evaluate and validate a whole network infrastructure combined with a risk assessment. This will be certainly required for complex systems.

Which information about environmental properties should be included in the documentation for customers? Give some examples.

Answer: For example energy consumption, batteries, runtime…

Chapter 11.1: Laws Concerning Reuse – an Overview

How a company besides an expensive analysis can make sure that prohibited substances are not included in a component?

Answer: By declaration of the supplier.

Which legal requirements do you find about reuse of E&E products? Which volumes should be reused?

Answer: WEEE, *Ecodesign Directive*. As much as possible should be reused. Targets are not given, but indirectly not fulfilled recycling volumes can be compensated by reuse.

From where do you get information about legal requirements in other countries?

Answer: By industry associations with international contacts. On top in Europe it is *Business Europe* and many branches of special associations.

Chapter 11.2: Industrial Standards – How to Use Them

What could be the target of the European Commission to give IEC TC 111 the task to develop international standards although the legislation is valid only in the European Union?

Answer: International standards open international markets and care for identical conditions world wide.

Please describe some differences between a standard, a PAS (publicly available specification) or a TR (technical report). Use the internet for search.

Answer: An international standard will be internationally accepted. A PAS will be a standard for test, if not renewed it disappears again. A TR is a pre-stage of a standard: It widely covers internationally accepted rules and procedures. It is therefore good for discussion within the experts. But it also can be applied widely such as a standard if no other rule is available.

Chapter 11.3: Accommodation to Pre-defined Conditions

Find out by contacting your local recycler which plastics and which metals they collect separately or which they dismantle for a materials recycling.

Answer: You will see that recycling is different for different recyclers. Many materials can or will not be recycled.

Chapter 11.4: The Role of Software

Using the internet identify examples for reuse of hardware and software together. For example in automobile industry. What is required. Name some products where cyber safety might play a role during reuse.

Answer: For many companies quality patterns are published e.g. AUDI.
Cyber safety might play a role if the software is not protected.