Ethical Aspects in Embedded Electronic System Design

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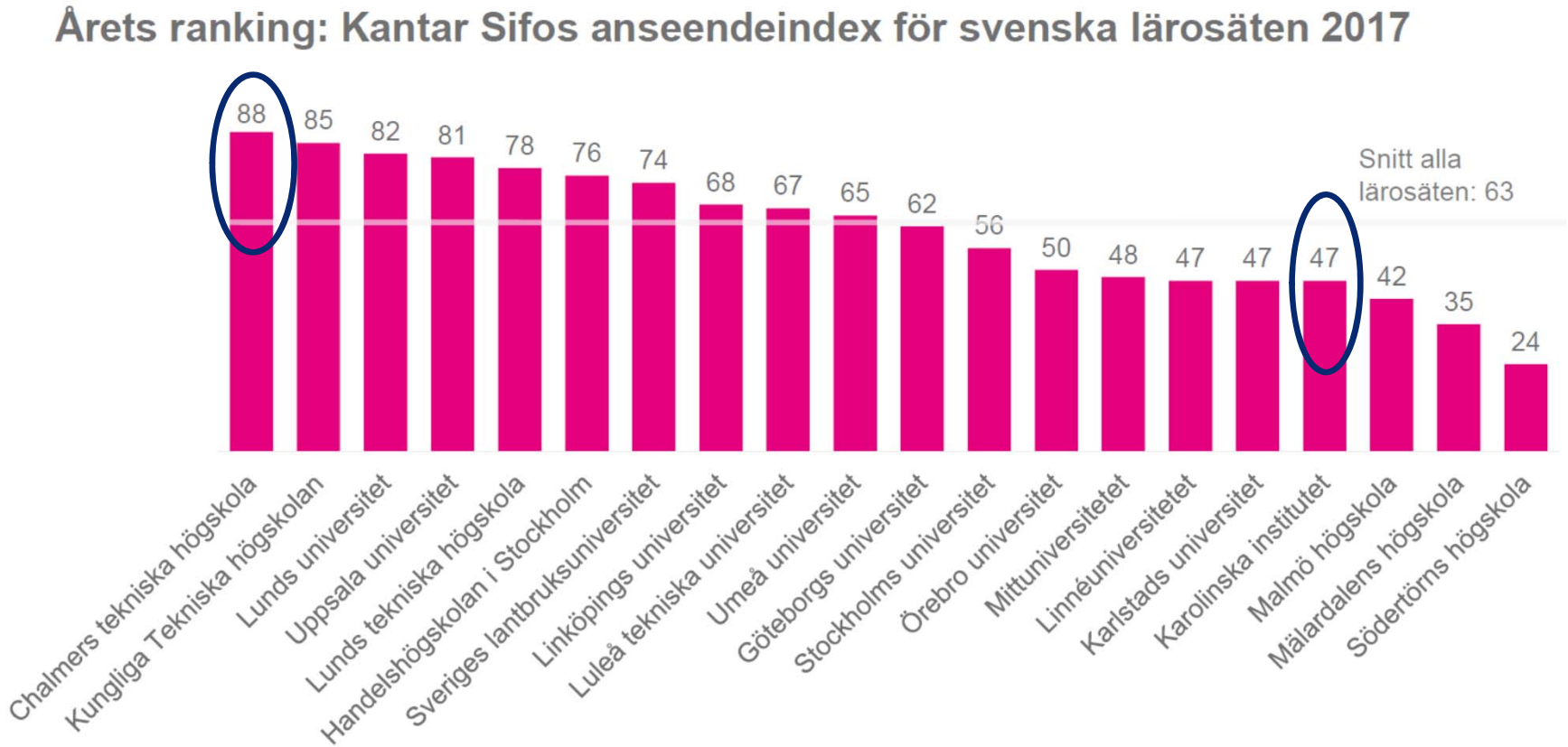
Ethics

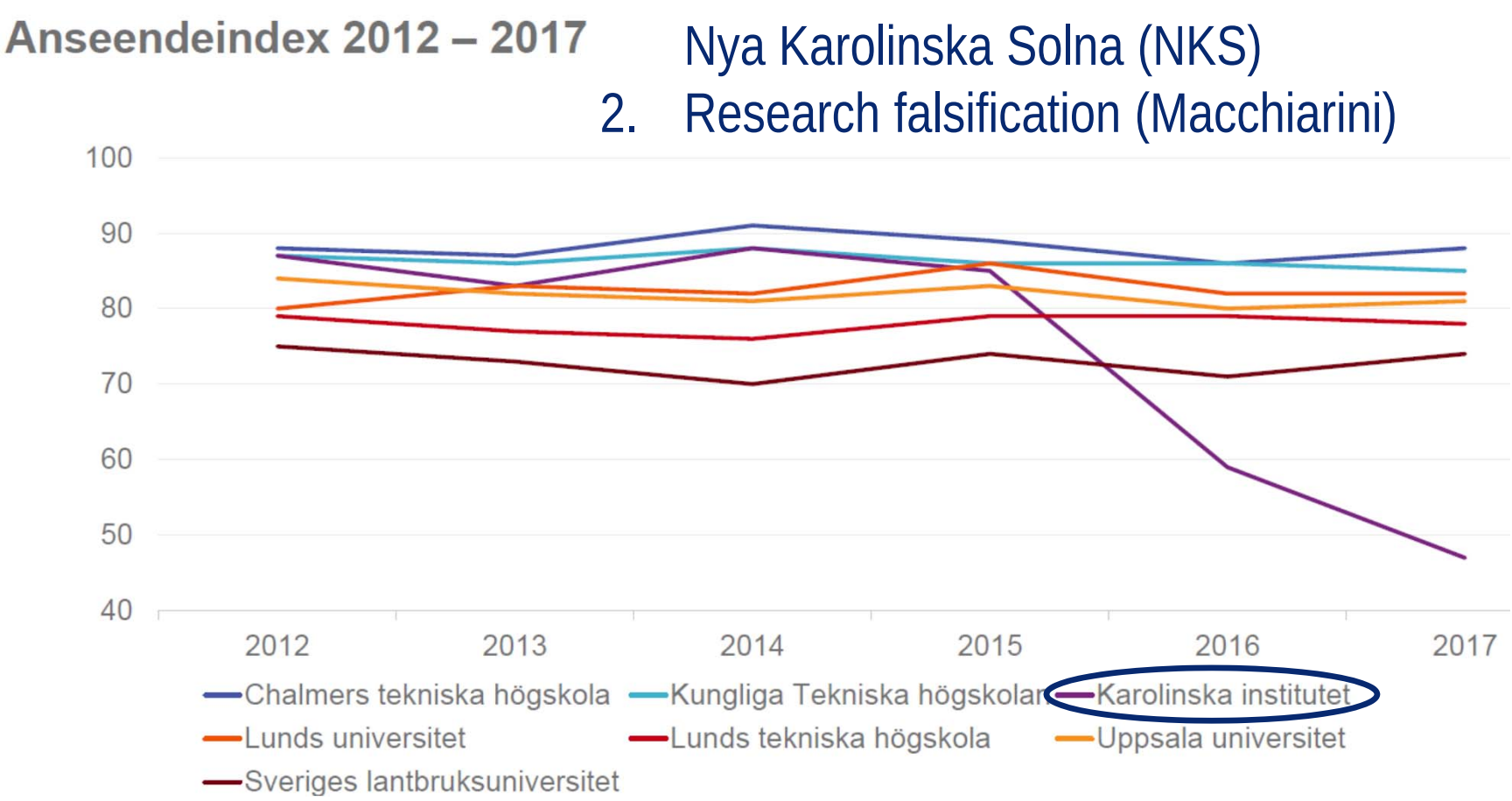
- Technology and use of the same change rapidly.
  - "Good" vs "evil" technology (use)… decisions.
  - Individual vs collective: Projects involve many people; how should the individual act … work ethics.
  - Ever more complex technology => few will understand what we do. Need moral compass!
- Ethics is a necessary component in our programs, however, it is difficult to integrate since it isn't "exact" in the same way as engineering is.

Reputation at Stake?



Reputation at Stake!

1. Excessive costs for Nya Karolinska Solna (NKS)
2. Research falsification (Macchiarini)



Examples of Ethical Dilemmas

- Mining of conflict minerals (later example).
- Medical electronics; in situ test and deployment.
- Mobile electronics; surveillance.
- Military electronics; accomplice in killing.
- Vehicle electronics; safety.
- Proprietary vs open source IP blocks.
- Work method; how to gather data.
- Writing; how to present material.
- Citation; how to refer to other people’s work.

Advancement of Technology

- Consider working on enhancing a weapon system where the purpose is to make the weapon more accurate.
- The reason for this project would be to limit collateral damage. Compare to past wars, where indiscriminate warfare has been practiced with horrible results.
- Good or bad?

Example Code of Ethics

- Code of Ethics/Conducts;
  a contract for professionals in an area.
- Excerpt from IEEE:
  - to accept responsibility in making decisions consistent with the safety, health, and welfare of the public…
  - to be honest and realistic in stating claims or estimates based on available data
  - to reject bribery in all its forms
  - to improve the understanding of technology; its appropriate application, and potential consequences

Terminology

- While ethics and moral basically mean the same, *how to act in a correct and responsible way*, they apply to different contexts:
  - Ethics relates to what is right in the context of a large group of people, what is the norm for the workplace etc.
  - Moral relates mainly to the individual.
- Ethics is in focus in this lecture since we are discussing our profession in the EESD area.

Research vs Engineering

- Research ethics.
  - Ethical aspects of publishing (part 2 of today's lecture).
  - Independent work. Lack of hierarchy.
    Moral compass essential.
- Engineering ethics.
  - Ethical dilemmas in application and development of advanced technology.
  - Project-oriented work. Many relations.
    Strong hierarchies.

Normative Ethics – How You Ought to Act

- Teleology (or consequentialism): consequences matter.
  - Holistic.
  - Can clash with moral of a person (violating one's conscious).
  - Utilitarianism (cost-benefit analysis).
- Deontology: act from duty (one's duty, others' rights).
  - Rightness or wrongness has nothing to do with consequence.
  - Individually oriented, "Respect for persons".
  - Rule priority is complex; rules may clash with common morality.
- Few subscribe to any particular moral theory, but switch depending on situation.

Utilitarianism

- Radical paradigm shift (Jeremy Bentham, 1748-1832): Happiness for all people!
- Weigh in consequence for all people concerned, weigh in consequence for environment, …
  - Many different factors can be considered, some of which may be hard to quantify.
  - Humans is one factor; contrast this with deontology which “protects” the individual (never sacrifice anyone).

Right of Conscience

- Utilitarianism is likely to clash with human dignity, by violating the conscience of an individual.
- The right of conscience is not part of any codes of ethics; whether it should be, is currently debated.
  - Sinneslagsetik (Swedish): the value of an act is decided by the intent.
- When a task violates the conscience of an individual, someone else may carry out this task; this is of relevance in e.g. health care.

Virtue-Based Ethics

- Ancient theory (Aristotle, Plato: the cardinal virtues).
- No guidance on actions (thus, one slide only:-),
  only concerned with character traits.
  - Encouragement of some virtues
    (which can be dependent on profession).
  - Revived in feminist ethics; ethics of care.
- Important as a driver of code of ethics.
  Aspirational ethics;
  what person do you want to become?

Technology and Society 1(2)

- Technology impacts society.
  - Technology impacts the way we interact (ease of travel and communication).
- Society impacts technology.
  - Green IT makes us emphasize *energy* efficiency.
- Privacy concerns.
  - Extensive information monitoring to catch bad guys, at the expense of integrity of (innocent) individuals.
- Middle way solutions, to balance social utility (utilitarianism) and personal privacy (deontology).

Technology and Society 2(2)

- Technology impacts society in a good way.
  - Enables prosperity.
  - Eradicates diseases.
  - Enabler of sustainable development (/unit)
- Technology impacts society in a bad way.
  - Integrity of the individual is threatened.
  - The family structure is being disrupted.
  - Environment is threatened (#users).
- No way of halting technological advancements, only a matter of finding the right direction.

Intellectual Property

- Intellectual Property (IP): creations of the mind, such as designs and implementations.
  - Reusable descriptions of layouts, cells, HDLs, architectures, etc.
  - Soft vs hard IP blocks.
- Since it is very easy to access (and abuse) IP, ethical aspects come into play.
- Proprietary vs. open-source IP blocks.
  - OpenCores.

Responsibility

- Advanced or mature technology.
  - Society is suspicious of new technology.
  - At the same time, advanced technology/engineering is hard to assess. Inner moral compass needed.
- As engineer you are responsible for designs.
  - Responsibility to accomplish project tasks.
  - Responsibility for product (use and misuse!).
- Complex projects.
  - Responsibility becomes collective (the company?).

Example Policy 1(2)

Conflict Minerals Policy:
In order to address concerns that certain metals used in electronics products may be sourced from conflict regions in the Democratic Republic of Congo (DRC) and adjoining countries, we have established a policy prohibiting the use of these metals if sourced from DRC conflict regions, and we have communicated this expectation to our suppliers. We are establishing due diligence programs using industry standard practices to evaluate the source of these metals within our supply chain and will take appropriate action to ensure we comply with applicable customer and regulatory requirements.

Example Policy 2(2)

GLOBALFOUNDRIES will not accept DRC conflict minerals in its products or production processes. We will exercise due diligence to ensure that materials purchased do not contain DRC conflict minerals. We have communicated our expectations to affected suppliers that they adopt a supply chain policy not to source conflict minerals. We require our suppliers to exercise due diligence to ensure that materials supplied to GLOBALFOUNDRIES do not contain DRC conflict minerals.

Code of Ethics/Conduct

- Different professions have different CoE / CoC.
- Engineers don't have any special authority, any licenses (like in health care, law enforcement).
- IEEE Code of Ethics (*What if you are not member:-)*
  - We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

IEEE Code of Ethics 1(2)

- to accept responsibility in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;
- to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
- to be honest and realistic in stating claims or estimates based on available data;
- to reject bribery in all its forms;
- to improve the understanding of technology; its appropriate application, and potential consequences;
- to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;

IEEE Code of Ethics 2(2)

- to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
- to treat fairly all persons and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;
- to avoid injuring others, their property, reputation, or employment by false or malicious action;
- to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

CoE … the Bare Minimum

- Code of ethics is strongly linked to deontological ethics where rules (often prohibiting) are used.
- But rules tend to give a “minimum level of ethics”; what about engineers and scientists that want to do even “more good”, beyond the call of duty?
- Virtue-based ethics for professional engineers => desirable character traits: professional pride, social and environmental awareness.
  - Whistleblowing takes a special character trait (courage) do to something many consider disloyalty.

Research Ethics

- #researchers increases + ease of “writing” * => risk of research misconduct:
  - Fabrication (adding data),
  - falsification (modifying data/method),
  - plagiarism (copying published material), and
  - self plagiarism (publish the same material again).

** http://pdos.csail.mit.edu/scigen/*

** Herbert Schlangemann (http://diehimmelistschoen.blogspot.se/)*

Ethics in the Work Place

- Applicable both to engineering and research.
- Confidentiality.
  - Protect information and know how.
- Conflicts of interest.
  - Be aware of influence of personal network.
- Whistleblowing.
  - Responsibility to expose illegal and dishonest activities.
- Approach to risks, in group work.
  - Need to be upfront about risk taking.

Publish or Perish

- Competition for academic positions is fierce => publication pressure = long publication lists.
- Least Publishable Unit … quantify over quality.
  - Long list yes, but will the work be considered important? Will it be cited? What about moral compass?
- On the other side of this gray zone, self plagiarism: Send the same work, perhaps with different titles, to many fora.
  - Simultaneous paper submission is explicitly prohibited in most conferences.

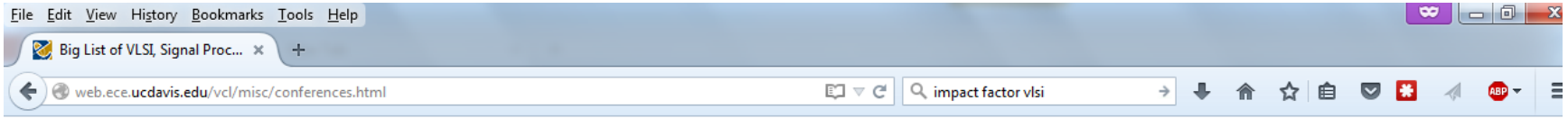
Publication Process

- Identify forum.
  - Journal: Scope, impact factor, page count.
  - Conference: Scope, impact factor, page count.
- Research work; data gathering; author list…
- Paper outline and writing.
- Submission for review:
  - Peer review. Outcome: Reject or accept.
- Camera-ready paper.
- Presentation (if conference).

Identify Forum

- Reviewing using top scholars/industry experts ensures research misconduct is discovered.
  - This high quality review only exists in top conferences and journals.
- Mechanisms for fair review in some areas:
  - Blind review or double blind review.
  - Declare Conflict of Interests with reviewers.
- Review process varies:
  - From accept/reject as feedback …
  - to comprehensive feedback from five reviewers.

Impact Factor Lists ...



Journals and Magazines

Published Title	Impact Factor (2009)	Eigenfactor (2009)	SJR Indicator (2008)	Special Issues
IEEE				
Proceedings of the IEEE	4.878	0.03257	0.274	None
Journal of Solid-State Circuits (JSSC)	3.151	0.04755	0.698	Closed submissions (i.e. invited only): ISSCC (Dec/Jan), VLSI Symp. (Apr), RFIC (May), ESSCIRC (Jul), CICC (Aug), Bipolar/BiCMOS Circuits and Technology (Sep), CSICS (Oct), A-SSCC (Nov)
Solid-State Circuits Magazine	-	-	-	None
Transactions of Circuits and Systems I (TCAS-I)	1.420	0.02584	0.158	Blind Signal Processing (Due Aug. 14, 2009) Special Issues
Transactions of Circuits and Systems II (TCAS-II)	1.320	0.01830	-	High-Performance Multi-Chip Interconnections (Due Oct. 15, 2009) Special Issues
Transactions on Circuits and Systems for Video Technology (TCSVT)	2.548	0.01519	0.110	Special Issues
Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)	1.230	0.00908	0.074	NOCS 2009 (closed submission) Special Sections
Transactions on Biomedical Circuits and Systems (TBCAS)	1.741	0.00098	0.175	Closed submissions (mostly) from BioCAS and ISCAS
Circuits and Systems Magazine	1.148	0.00190	0.164	None
Transactions on Very Large Scale Integration Systems (TVLSI)	1.010	0.00929	0.075	Special Sections

High Impact Only?

- Much of our research is done by PhD students who need scientific papers for their PhD theses and general experience from (conference) networking.
- Aiming for highest impact leads to rejections.
  Too risky for the average rookie PhD student.
- Lower impact fora initially.
  Increase fora quality gradually.

Authorship

- Papers are hard currency so authorship is important.
- Authorship [*def. University of Western Australia, Vancouver rules*] criteria:
  1. conception and design,
     or analysis and interpretation of data.
  2. drafting the article or
     revising it critically for important intellectual content.
  3. final approval of the version to be published.
  - these are strict criteria that are rarely used =>
    biased CVs (include “famous researcher to improve chances”, include “researcher who owns equipment”, …)

Current Example, 1

CENTRAL ETHICAL REVIEW BOARD
Expertgruppen för oredlighet i forskning

STATEMENT Ref. no. O 1-2016
6 September 2016

University that requested the statement

Karolinska Institutet
SE-171 77 Stockholm

Background

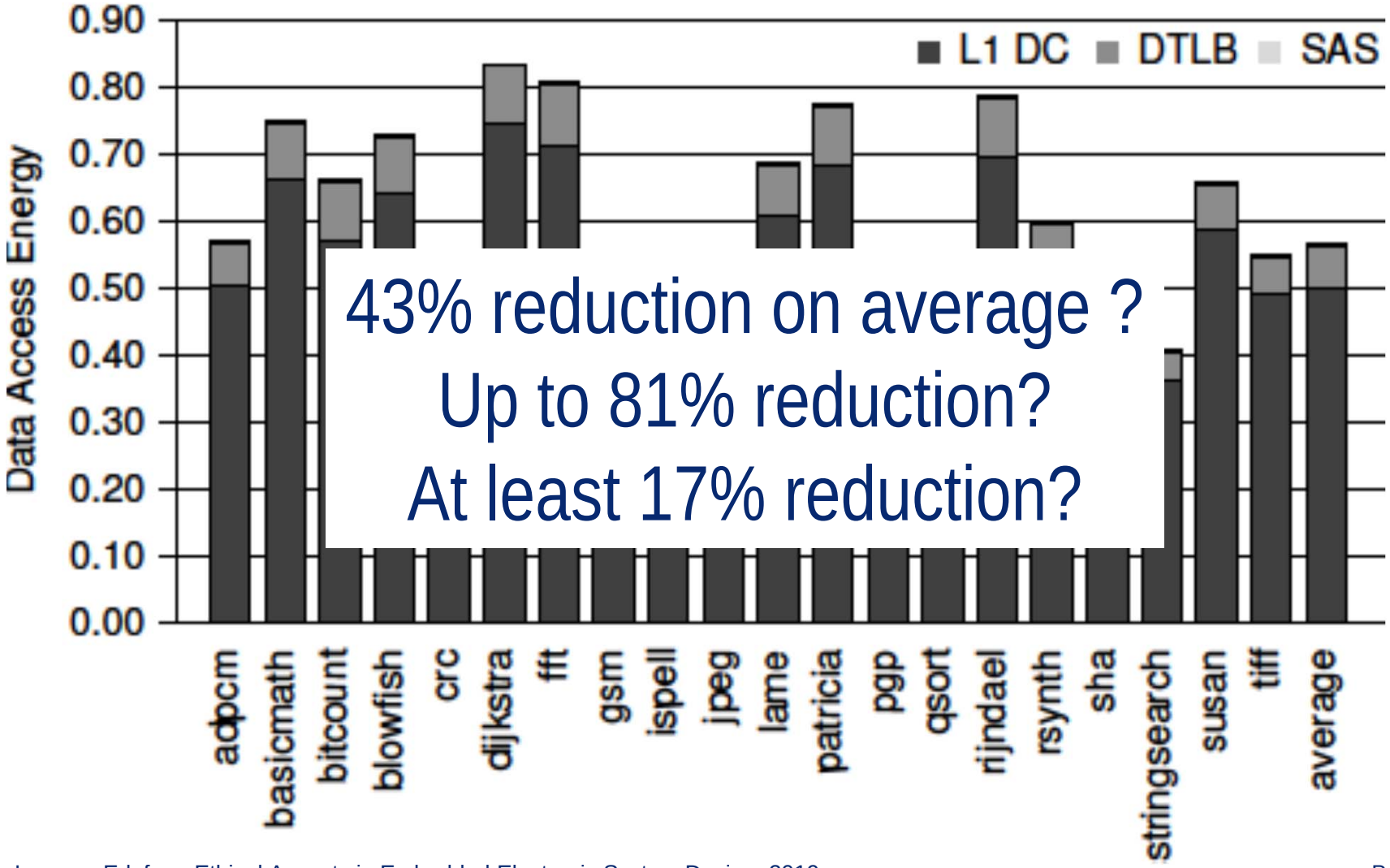
In a petition received on 29 February 2016, Karolinska Institutet has requested a statement from the Expert Group for Misconduct in Research at the Central Ethical Review Board. The petition includes a reference to a letter of allegation from Oscar Simonson, Matthias Corbascio and Karl-Henrik Grinnemo. According to the petition the authors are, by publishing the scientific article "Experimental orthotopic transplantation of a tissue-engineered oesophagus in rats", included in Nature Communications (2014;5:3562) journal, guilty of scientific misconduct. The authors of the scientific article are Sebastian Sjöqvist, Philipp Junglebluth, Mei Ling Lim, Johannes C Haag, Ylva Gustafsson, Greg Lemon, Silvia Baiguera, Miguel Angel Burguillos, Constantino Del Gaudio, Antonio Beltran Rodriguez, Alexander Sotnichenko, Karolina Kublickiene, Henrik Ullman, Heike Kielstein, Peter Damberg, Alessandra Bianco, Rainer Heuchel, Ying Zaho, Domenico Ribatti, Cristian Ibarra, Bertrand Joseph, Doris A Taylor and Paolo Macchiarini. The Expert Group has been asked to provide a statement on whether the

Current Example, 2

The question regarding who can be held responsible for the scientific misconduct also arises. There is no doubt that the article's main author, Paolo Macchiarini, has the main responsibility for the content of the article and that he is therefore guilty of misconduct in research.

As regards the responsibility of the other co-authors, the Expert Group's assessment is as follows. In accordance with good scientific practice all co-authors must approve the latest version of the script and thereby assume responsibility for the same. The scientific and co-authors' contributions should be identifiable, which is largely not the case in the article which is by itself reprehensible. A scientific article with several co-authors is a joint endeavour with collective responsibility. If one scientific article is deemed to be marred by serious shortcomings grave enough to constitute scientific misconduct, the responsibility therefore falls on all the co-authors. This also applies, as in this case, where the majority of the co-authors' specific contributions to the article are not specified and where it's one person's word against the other on key points. Some of the authors of the article, except for Paolo Macchiarini, have had a more prominent role than others. Amongst them it is clear that Sebastian Sjöqvist and Philipp Jungebluth have had key roles in the research process.

Presenting Results 1(2)



Presenting Results 2(2)

- Make fair comparisons.
  - BKM (best known method) to challenge your results.
  - Conventional method to which everyone can relate.
- Review assumptions. For example, 2.3 W of power dissipation conveys little information:
  - What supply voltage?
  - What frequency of operation, if digital?
  - What input stimuli?
  - What process corner, if ASIC?

Summary

- Currently focus on science and technology content in engineering and research training. But there are many ethical issues that our EESD graduates will be facing in their professional career.
- Although ethics deals with right and wrong, it makes little sense to try to identify right and wrong for a particular ethical dilemma. Training ethics is about raising an awareness and stimulating a discussion.

Assignment

Ethical Decision Making

- Framework for ethical decision making [Adawi05.pdf].
  1. Determine facts and identify ethical issues.
  2. Identify stakeholders and consider your ethical obligations.
  3. Identify options and consider possible consequences.
  4. Make an assessment of your decision and decide on a plan for action.

Assignment

- Based on a background story, you are to write a reflective note on your view of the ethics dilemma of the story.
- Some dilemmas/questions can be answered yes/no, but that is not the intention. Rather, try to elaborate on the answer.
- In the following, I provide six different background stories...

Story 1

- Consider that you are being hired to work on enhancing a weapon system where the purpose is to make the weapon more accurate. The purpose of this project would be to limit collateral damage. Compare to past wars, where indiscriminate warfare has been practiced with horrible results.

Would you accept the job offer and join this project?

Story 2

- Consider working on a project where a new test mode is to be implemented. You receive limited information on the purpose of the test mode but some of your colleagues suspect that the mode may be used for another (implicitly sinister) purpose than testing.

What exactly is your personal responsibility in terms of finding more information on the purpose?

Story 3

- Consider working on a project in medical electronics where the system verification due to time limitations has to be finished before you feel confident that the system is fully verified. [Therac-25]

How should you act in relation to the management that is pushing you to cut back on system testing?

Story 4

- Consider working as electronics consultant on a project where you advise the client to carry out more extensive tests (than originally planned) on a system in which your design is a part. The system is critical and system failures may have devastating effects on national infrastructure.

Should you sign off the project without having any guarantees from the client to extend the system test? After all the system design is a responsibility of the client.

Story 5

- Consider that you are writing a scientific paper on a research project that you have participated in. On average, the evaluation results are looking very promising, but there is one data point in the evaluation that is dramatically different from the average. You have analyzed the evaluation results, but still you don't really know the reason for the outlier result.

How should you present the results in the scientific paper?

Story 6

- You are collaborating with another team. Now it is time for you and the other team to write up a research paper that will be decisive for the continuation of the project. The other team has started writing the paper and already their draft is including a section on the evaluation methodology. The problem is that you have started to doubt parts of the evaluation methodology used by the other team.

As far as the methodology presented in the paper, and the effect this may have on the results, what is your responsibility as co-author: Should you demand a rewrite, should you withdraw your name from the co-author list, or what?

Examination

- The reflective note should be submitted (as PDF) by Friday March 8, at the latest.
  - Pick one story.
  - The answer/discussion should be kept short, and must fit on one page.
  - Elaborate on the ethics dilemma.
  - Don’t hesitate to pick a side (“in favor” or “against”).
- Grade is either Pass or Fail.

References

- *Teknik och etik*, Sven Ove Hansson, KTH, 2009.
- *Engineering ethics*, 5th ed, Charles Harris, et al., Wadsworth Publishing, 2014.