Aalto University

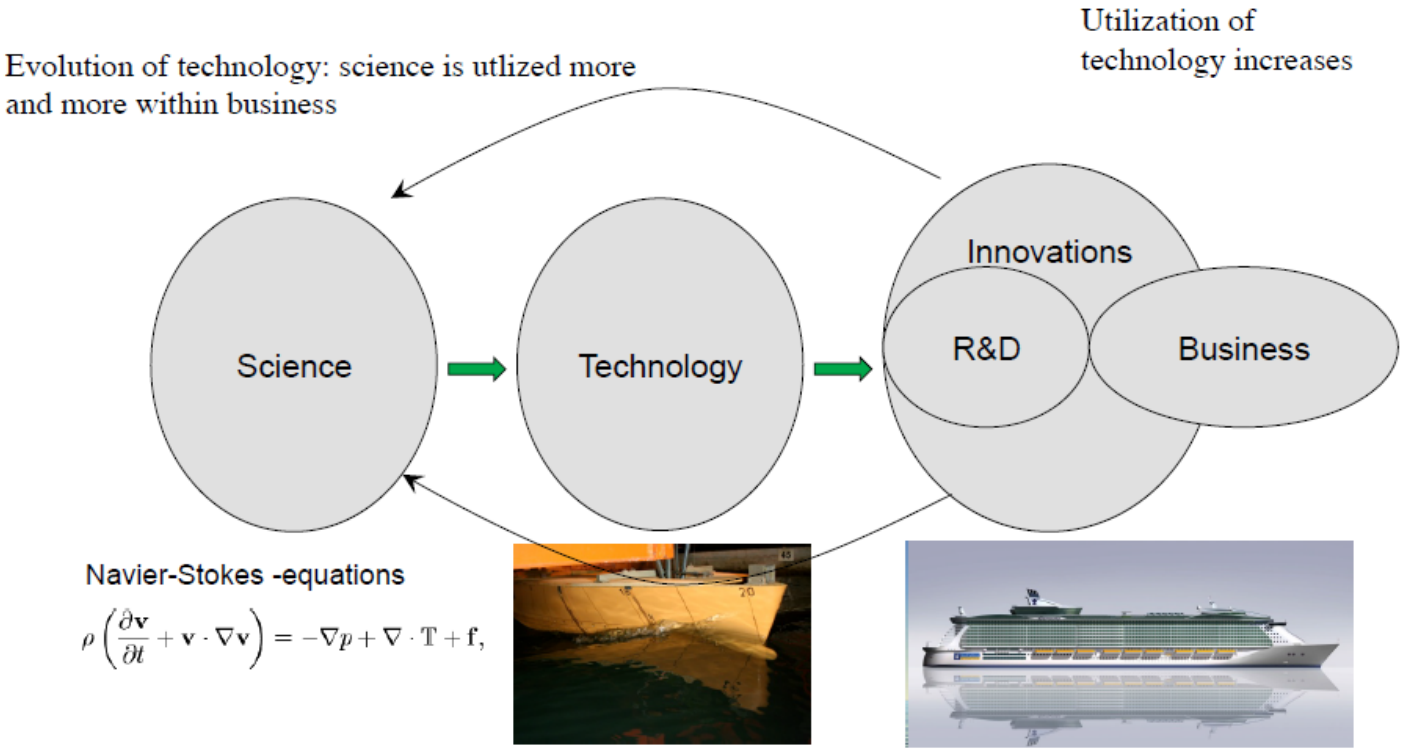
School of Engineering

Meriteollisuuden tulevaisuudennäkymät, Palace 13.10.2015

Osaamisen merkitys suomalaisen meriteollisuuden kannalta

Jani Romanoff

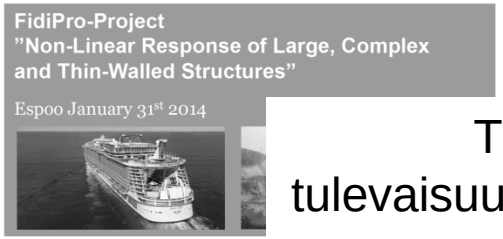
The Framework of Engineering and Science



Scientific community

Scientific breakthrough

Science

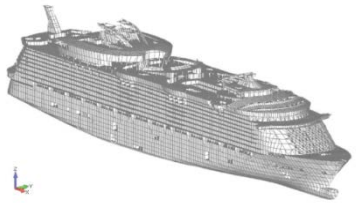


Tiedeyhteisön rooli on kouluttaa tulevaisuuden osaajat sekä tuottaa uutta tietoa ja varmentaa tiedon oikeellisuus tieteen keinoin

Talented students

Research transfer

Doctoral students



Start-up (Doctors)

Innovative products

Society

Industry

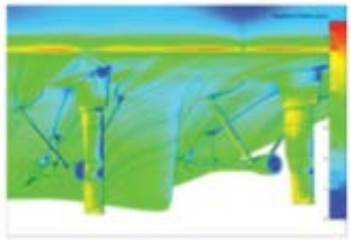
Aalto University
School of Engineering

Kohdennettu tutkimus yritysten tarpeista lähtien – osaamisen kasvattaminen

MERITEOLLISUUS
Finnish Marine Industries

Figure 3.

Technologies that enable innovative ship concepts; new hull layouts, modular cabin areas, sail technology, optimized propulsion systems.



Kohdennettu tutkimus yritysten tarpeista lähtien – osaamisen kasvattaminen

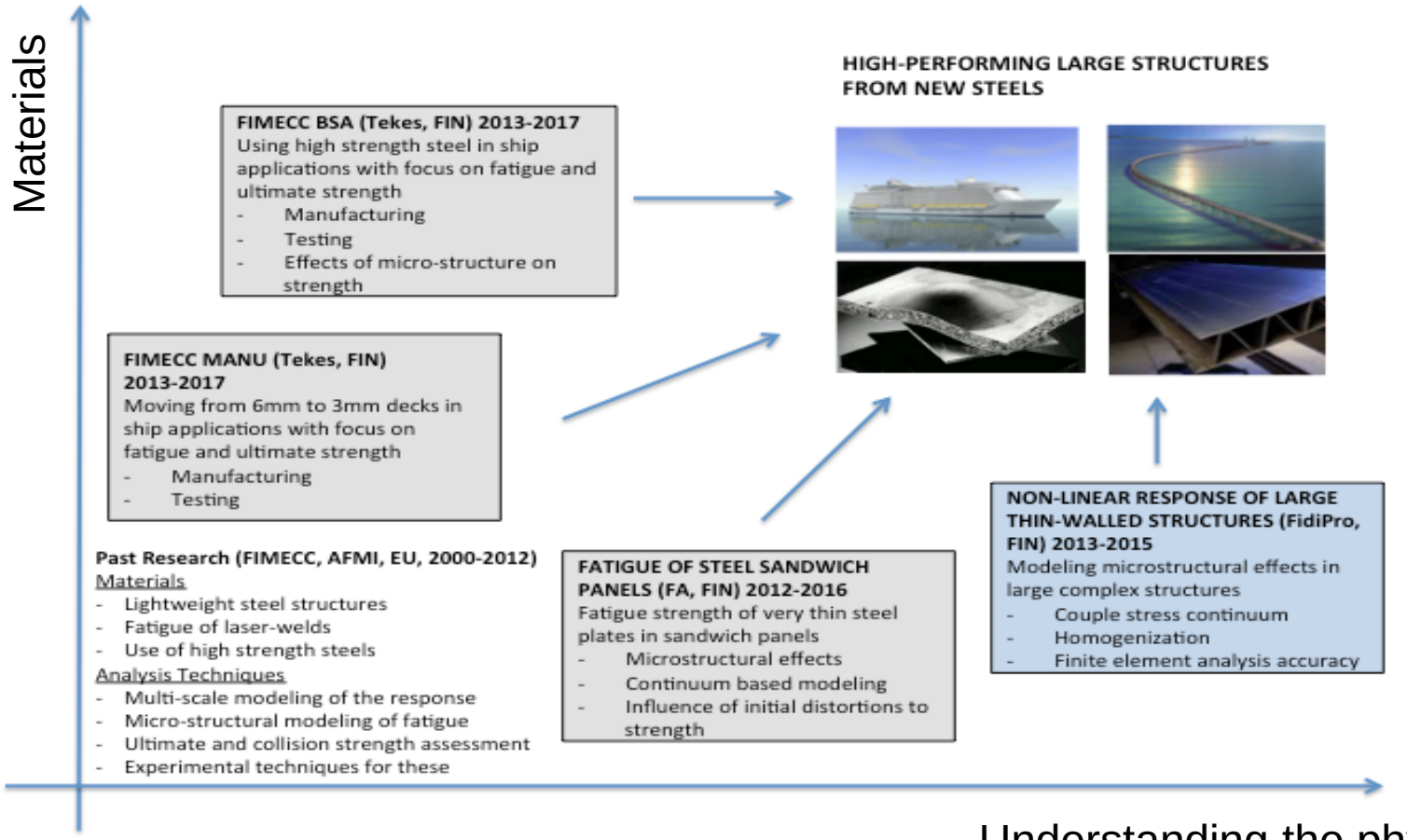
MERITEOLLISUUS
Finnish Marine Industries

Table 1.

Summary of the strategic research themes for cruise and ferry.

Objective	Competence development	Energy and enviroment	New business models
New product or concept	• Cruise & ferry product has improved earning potential and added value for the customer • Lightweight ships; e.g. -15-20% in weight • Safe ships with high levels of comfort	• Towards zero-emission ships, -50% reduction in energy consumption and CO2 footprint • Control of upcoming SOx and NOx requirements • Environmental sustainability	• 30% more efficient shipbuilding and shorter build time • Efficient and competitive networks
Integration of innovation	• Use of modular building in production of complex structures • Development of 3D tools for design and manufacturing • Impact on rules	• Methods for waste heat recovery • Methods for renewable energy utilisation • Impact on rules	• Development of network management • Testing and implementation of new production methods • Better utilisation of networks in low cost countries
Innovation and application	• New main structural concepts • New, lightweight materials and structures • Development of intelligent management systems • Advanced production technology applications	• Improved waste management • Waste heat recovery systems • Alternative fuels and energy sources; i.e. LNG • New emission-reduction methods • Lifecycle assessment tools to optimise ship systems	• New effective, more flexible and streamlined shipbuilding process
Basic research	• Cost and weight-effective main structural solutions • New materials and structures; e.g. steels and composites • New cost-effective production methods for large complicated structures; e.g. laser welding. • Development of strength analysis methods	• Development of hydrodynamics and propulsion in operational conditions • Lifecycle assessment tools for ships • Future waste heat recovery systems • Future energy sources • Sustainable use of materials	• New business models for Finnish maritime industry networks • Dynamic optimisation of production network • Analysis and development of sustainable production chain and operation methods

Huippututkimuksen ja osaamisen tavoitehakuinen suunnittelu yliopiston kannalta



Esimerkki tutkimustyhteistyöstä vuosien varrella
(Meyer Turku, Meyer Werft, SSAB, DNV-GL…)

Finnish Academy of Sciences

- Doctoral project 2000-2003 – Fatigue strength of laser butt welds
- **Research Project 2011-2015: Fatigue Strength of Steel Sandwich Panels**

Aalto University

- Post Doctoral project 2009-2011 – Ultimate strength of laser stake welds
- **Post Doctoral project 2013-2014 – Fatigue strength of steel sandwich panels**

Ministry of Education

- **Graduate School in Engineering Mechanics** – Steel sandwich panels (2000-2004, 2009-2011), Ship collisions (2007-2008, 2010-2013) and Fatigue of Thin Decks (2011-2014)
- Department of Mechanical Engineering – Collision resistant structures

Association of Finnish Industries

- SUTERA 2008-2010 – Filled, closed steel structures

Tekes

- KENNO 1998-2002 – Steel sandwich panels
- Törmäke 2003-2006 – Collision resistant ship
- ConStruct 2005-2008 – Conceptual design software for cruise ships

EU

- DISCO 2000-2003 – Innovative cruise ship concepts
- SANDWICH 2000-2003 – Steel sandwich panels
- MARSTRUCT 2004-2009 – Network of Excellence in marine structures
- SANDCOR.e 2004-2006 – Coordinated action of sandwich structures
- IMPROVE 2007-2009 – Development of novel ship concepts
- DE-Light Transport 2007-2009 – Development of lightweight transport units
- BESST 2009-2011 – Development of laser-welded ship structures

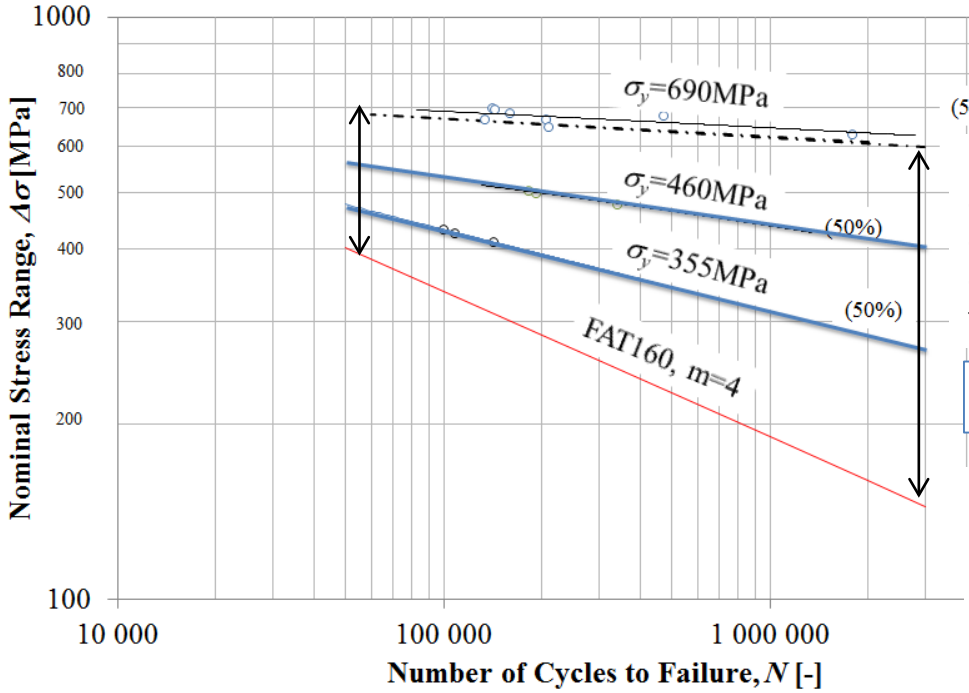
FIMECC

- 2009-2011: I&N – Passenger Ship Design and Light – Collision and Fatigue Strength
- **2014-2018: BSA – High Strength Steel in Marine Applications, MANU – Fatigue strength of advanced structures**

Commercial projects

Yhteistyöstä teollisuuden saama tulos

Kilpailukyky – kevyempi, energiatehokkaampi laiva



Korkealaatuinen rakenne
- suomalainen telakka
- suomalainen materiaatoimittaja
- suomalainen tutkimusrahoitusinstrumentti

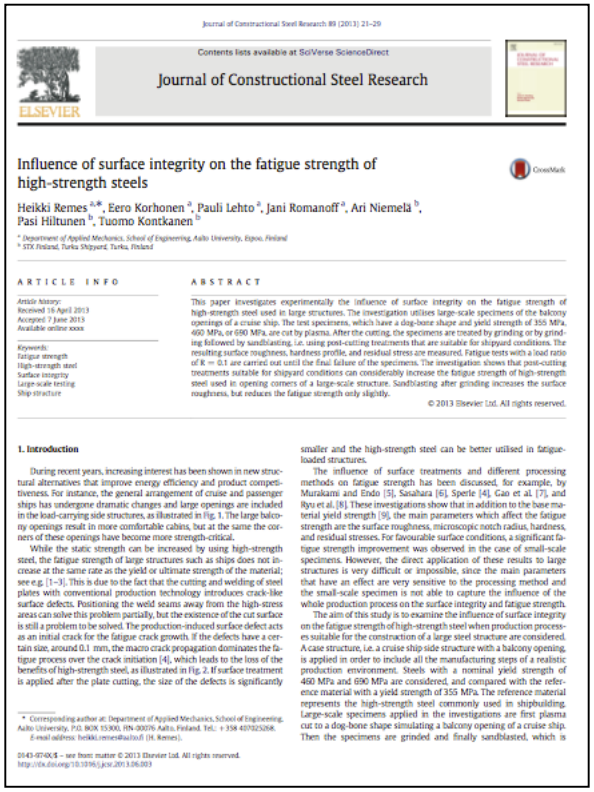
FIMECC LIGHT & BSA

Nykysäännöt
- kansainvälinen keskiarvo
- varmuuskerroin (laatu)

Remes, H., Korhonen, E., Lehto, P., Romanoff, J., *Niemelä, A., Hiltunen, P. and Kontkanen, T.,* "Influence of surface integrity on the fatigue strength of high- strength steels", Journal of Constructional Steel Research Vol. 89 (2013), pp. 21–29.

Yhteistyöstä yliopiston saama tulos

Suunnannäyttäjä kansainvälisessä tiedeyhteisössä



Journal of Constructional Steel Research 89 (2013) 21–29

Contents lists available at SciVerse ScienceDirect

Journal of Constructional Steel Research

ELSEVIER

Influence of surface integrity on the fatigue strength of high-strength steels

Heikki Remes [a,*], Eero Korhonen [a], Pauli Lehto [a], Jani Romanoff [a], Ari Niemelä [b], Pasi Hiltunen [b], Tuomo Kontkanen [b]

[a] Department of Applied Mechanics, School of Engineering, Aalto University, Espoo, Finland
[b] STX Finland, Turku Shipyard, Turku, Finland

ARTICLE INFO

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Keywords:
Fatigue strength
High-strength steel
Surface integrity
Large-scale testing
Ship structure

ABSTRACT

This paper investigates experimentally the influence of surface integrity on the fatigue strength of high-strength steel used in large structures. The investigation utilises large-scale specimens of the balcony openings of a cruise ship. The test specimens, which have a dog-bone shape and yield strength of 355 MPa, 460 MPa, or 690 MPa, are cut by plasma. After the cutting, the specimens are treated by grinding or by grinding followed by sandblasting, i.e. using post-cutting treatments that are suitable for shipyard conditions. The resulting surface roughness, hardness profile, and residual stress are measured. Fatigue tests with a load ratio of $R = 0.1$ are carried out until the final failure of the specimens. The investigation shows that post-cutting treatments suitable for shipyard conditions can considerably increase the fatigue strength of high-strength steel used in opening corners of a large-scale structure. Sandblasting after grinding increases the surface roughness, but reduces the fatigue strength only slightly.

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1. Introduction

During recent years, increasing interest has been shown in new structural alternatives that improve energy efficiency and product competitiveness. For instance, the general arrangement of cruise and passenger ships has undergone dramatic changes and large openings are included in the load-carrying side structures, as illustrated in Fig. 1. The large balcony openings result in more comfortable cabins, but at the same the corners of these openings have become more strength-critical.

While the static strength can be increased by using high-strength steel, the fatigue strength of large structures such as ships does not increase at the same rate as the yield or ultimate strength of the material; see e.g. [1–3]. This is due to the fact that the cutting and welding of steel plates with conventional production technology introduces crack-like surface defects. Positioning the weld seams away from the high-stress areas can solve this problem partially, but the existence of the cut surface is still a problem to be solved. The production-induced surface defect acts as an initial crack for the fatigue crack growth. If the defects have a certain size, around 0.1 mm, the macro crack propagation dominates the fatigue process over the crack initiation [4], which leads to the loss of the benefits of high-strength steel, as illustrated in Fig. 2. If surface treatment is applied after the plate cutting, the size of the defects is significantly smaller and the high-strength steel can be better utilised in fatigue-loaded structures.

The influence of surface treatments and different processing methods on fatigue strength has been discussed, for example, by Murakami and Endo [5], Sasahara [6], Sperle [4], Gao et al. [7], and Ryu et al. [8]. These investigations show that in addition to the base material yield strength [9], the main parameters which affect the fatigue strength are the surface roughness, microscopic notch radius, hardness, and residual stresses. For favourable surface conditions, a significant fatigue strength improvement was observed in the case of small-scale specimens. However, the direct application of these results to large structures is very difficult or impossible, since the main parameters that have an effect are very sensitive to the processing method and the small-scale specimen is not able to capture the influence of the whole production process on the surface integrity and fatigue strength.

The aim of this study is to examine the influence of surface integrity on the fatigue strength of high-strength steel when production processes suitable for the construction of a large steel structure are considered. A case structure, i.e. a cruise ship side structure with a balcony opening, is applied in order to include all the manufacturing steps of a realistic production environment. Steels with a nominal yield strength of 460 MPa and 690 MPa are considered, and compared with the reference material with a yield strength of 355 MPa. The reference material represents the high-strength steel commonly used in shipbuilding. Large-scale specimens applied in the investigations are first plasma cut to a dog-bone shape simulating a balcony opening of a cruise ship. Then the specimens are grinded and finally sandblasted, which is

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http://dx.doi.org/10.1016/j.jcsr.2013.06.003

MARSTRUCT 2013

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MARSTRUCT 2013

MARSTRUCT Virtual Institute

4th International Conference on Marine Structures

Tuesday, February 26, 2013

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MARSTRUCT 2013
4th International Conference on Marine Structures
25th – 27th March 2013, Espoo, Finland

The 4th MARSTRUCT Conference, following three successful conferences 2007 in Glasgow, 2009 in Lisbon and 2011 in Hamburg, will be organized at the Aalto University in March 2013. It has its origin in the MARSTRUCT Network of Excellence, but is becoming a series of Conferences dedicated to Marine Structures to allow periodic reporting and discussion of the advances in the field.

This fourth edition of the Conference aims at building on the previous ones and expanding it to a wider community interested in the various aspects related with Marine Structures, keeping a good standard of the proceedings which will be printed in books of published by Taylor & Francis in books.

The full papers will be peer-reviewed before acceptance, aiming at quality of the final publication, which is becoming a requirement for publications to be properly considered in the academic and research community. The best papers will be selected to special issue of international journal dedicated to Marine Structures. This Conference will rely on its Committees to be main contributing body to the review process and acceptance of the papers.

MARSTRUCT 2013 Call for Papers Second Announcement

Deadlines

Submission of Abstracts
15 September 2012
Submission of full-length paper
15 November 2012
Submission of revised papers
15 December 2012
Registration
31 December 2012

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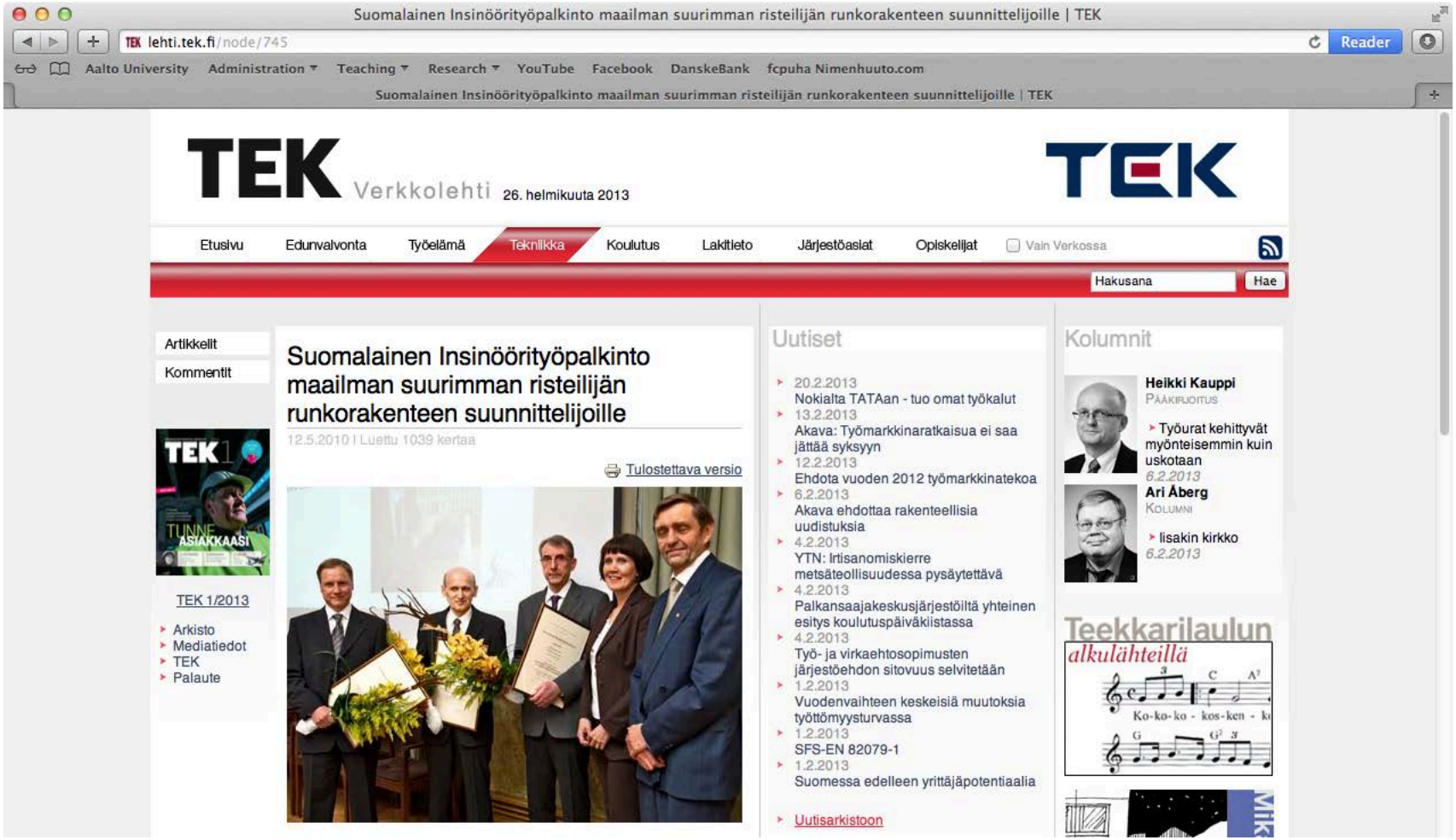
Tested for Internet Explorer 5+, Netscape 7+ and Mozilla 1.4+

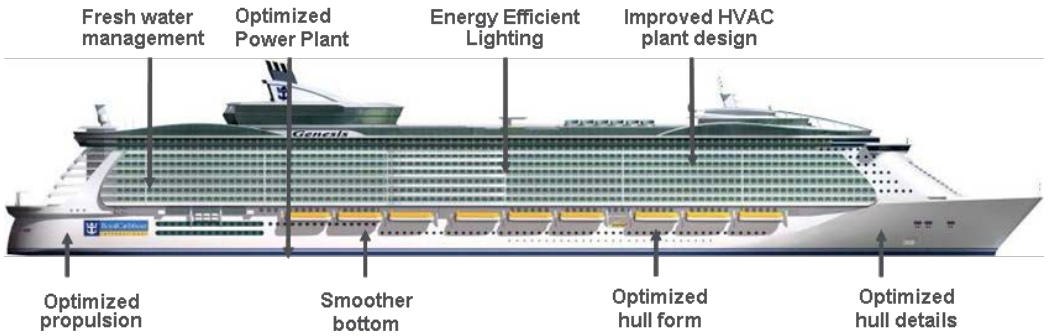
Travel Information

Aalto University
School of Engineering

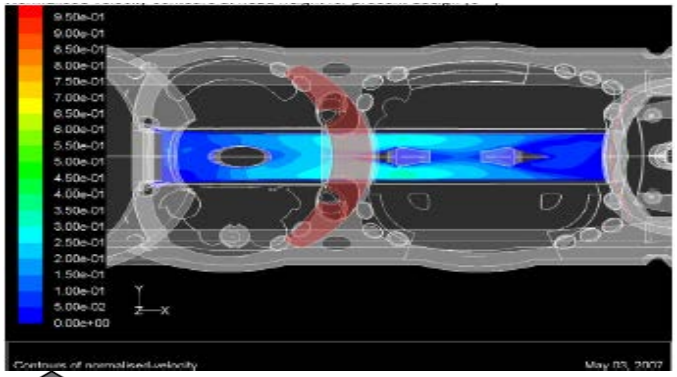
Meritekniikka=hightech?



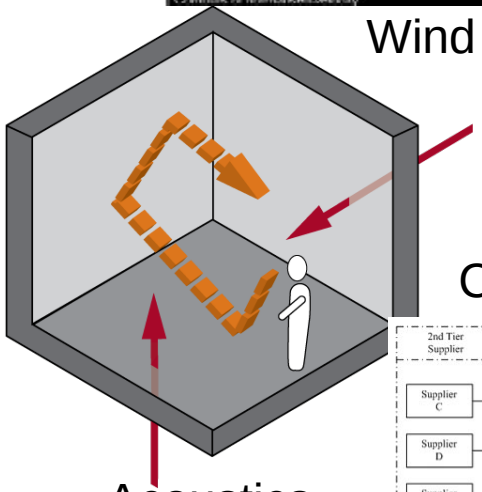
Huipputekniikkaa kerääviä tuotteita – monta samanlaista tarinaa…



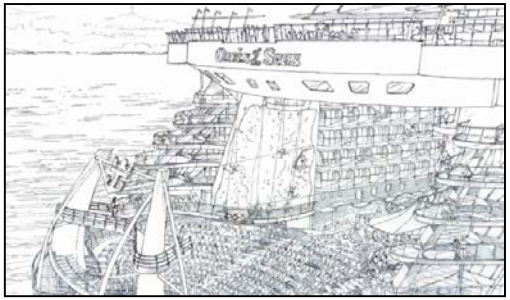
Energy Efficiency



Wind Comfort

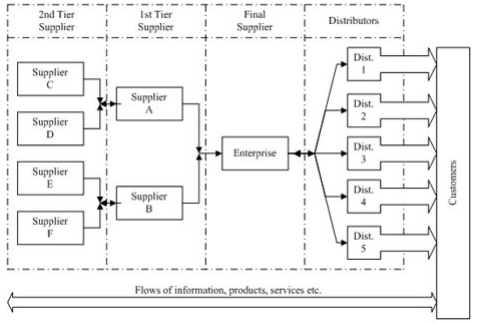


Supply Chain Mngmnt



Architecture & Design

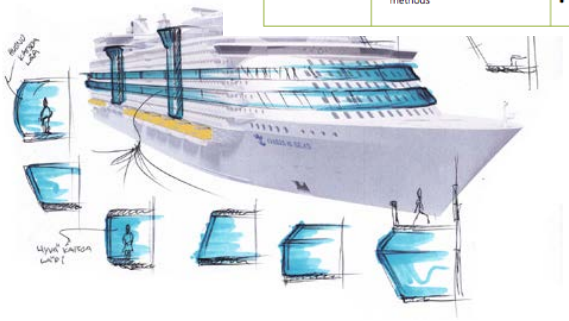
Acoustics



Information Technology

Uuden tutkimusagendan laatiminen 2015-2016

Määritetään tulevaisuuden kehitystarpeet



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Summary of the strategic research themes for cruise and ferry.

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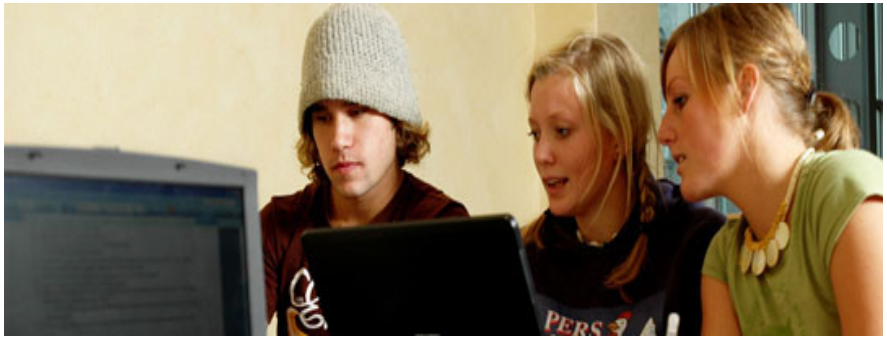
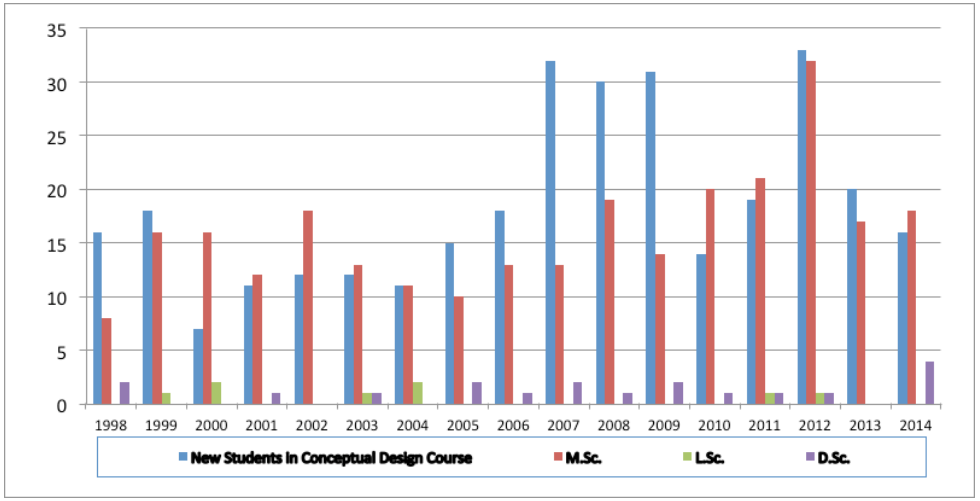
Innovation and application	• New main structural concepts • New, lightweight materials and structures • Development of intelligent management systems • Advanced production technology applications	• Improved … management • Waste … recovery systems • Alter… fuels and energy sources; i.e. LNG • New emission-reduction methods • Lifecy… …sessment tools to optimise … systems	• New effective, more flexible and streamlined shipbuilding process
Basic research	• Cost and weight-effective main structural solutions • New materials and structures; e.g. steels and composites • New cost-effective production methods for large complicated structures; e.g. laser welding. • Development of strength analysis methods	• Development of hydrodynamics and propulsion in operational conditions • Lifecycle assessment tools for ships • Future waste heat recovery systems • Future energy sources • Sustainable use of materials	• New business models for Finnish maritime industry networks • Dynamic optimisation of production network • Analysis and development of sustainable production chain and operation methods

Yhteistyö opetuksessa

- Maisteritaso (Aalto-yliopisto)
  - Sovelletun mekaniikan pääaineen erikoistumiskohde 1.5 vuotta opintoja + 0.5 D-työ (teoreettisesti vahva kandikoulutus pohjalla)
  - Aalto-tasolla poikkitieteellinen Cruise and Ferry – opintokokonaisuus (ENG, BIZ, ARTS) tulevaisuuden tuotekehittäjien koulutukseen (teollisuusohjausryhmä)
  - Kansainväliset N5T-ohjelma muita erikoisaloja varten (Aalto, CTH, DTU, KTH, NTNU):
    - Nordic master in maritime engineering: small craft, ship operations, ocean structures, ship design
    - Cold climate engineering: land, space and sea
  - Pyritään vastaamaan teollisuuden erilaisiin tarpeisiin yhteistyön kautta
- Tohtoritaso (Aalto-yliopisto)
  - Sovelletun mekaniikan osana
  - Tutkijakoulut, Suomen akatemia, FIMECC, EU,…
  - Seuraavan sukupolven suunnittelijat teollisuuteen ja opettajat





Esimerkki suomalaisesta huippututkimusalasta: LRF-Research Center: Arctic shipping and operations

Lloyd's Register Foundation

Aim and budget of the new Center

- Holistic treatment of the design relevant features of ships and shipping and their identification to ensure safe arctic operations and transport
- Funding for 5 years, 2013-2018, 2.5 Meuro
- Funding enables 8 doctor thesis
- 1st center of Excellence by LRF in Scandinavia
- The only center related to Artic activities

Key personell:

Professor Pentti Kujala / Aalto Univ.
Chair

Professor Jukka Tuhkuri / Aalto Univ.
Numerical ice load modeling

Professor Bernt Leira / NTNU
Probablistic ice load modeling

Professor Sören Ehlers / TUHH
Modeling of structure-ice interaction

Professor Brian Veitch / Memorial
Safety and risk modeling

Professor Faisal Khan / Memorial
Safety and risk modeling

Professor Sakari Kuikka /
Helsinki University
Modeling of environmental effects

Aalto University
School of Engineering

MEMORIAL UNIVERSITY

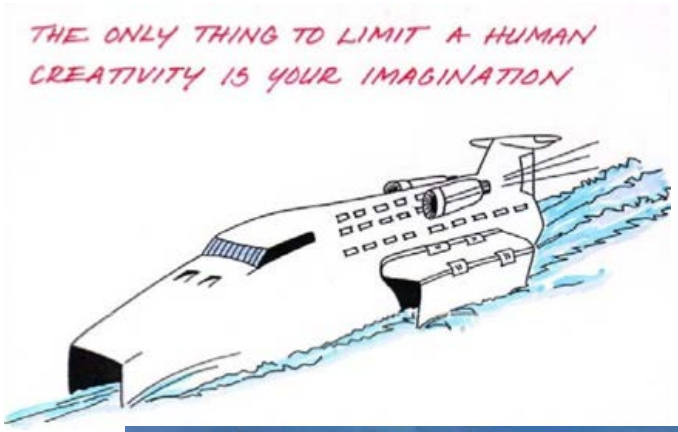
NTNU
Norwegian University
Science and Technolog

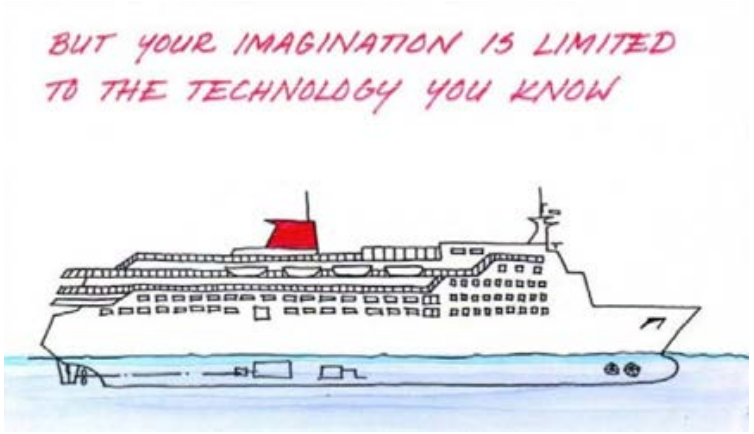
TUHH
Technische Universität Hamburg-Harburg

UNIVERSITY OF HELSINKI

Cruise and Ferry: yhteistyö teollisuuden kanssa opetuksessa

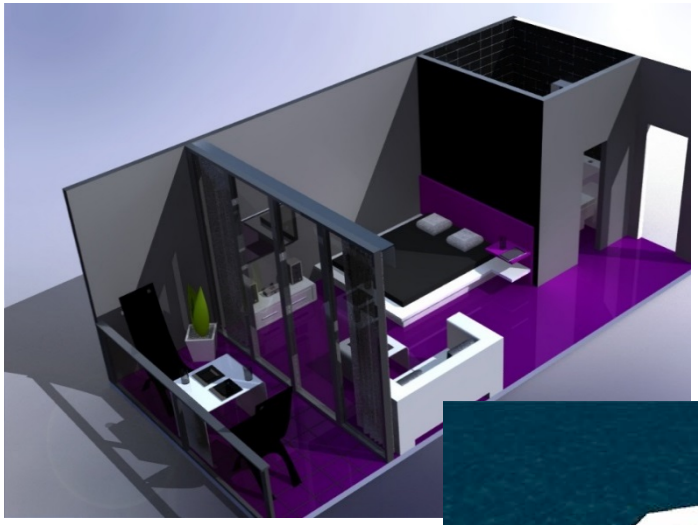
Matkustajalaivasuunnittelun uranuurtajan opit (K. Levander)

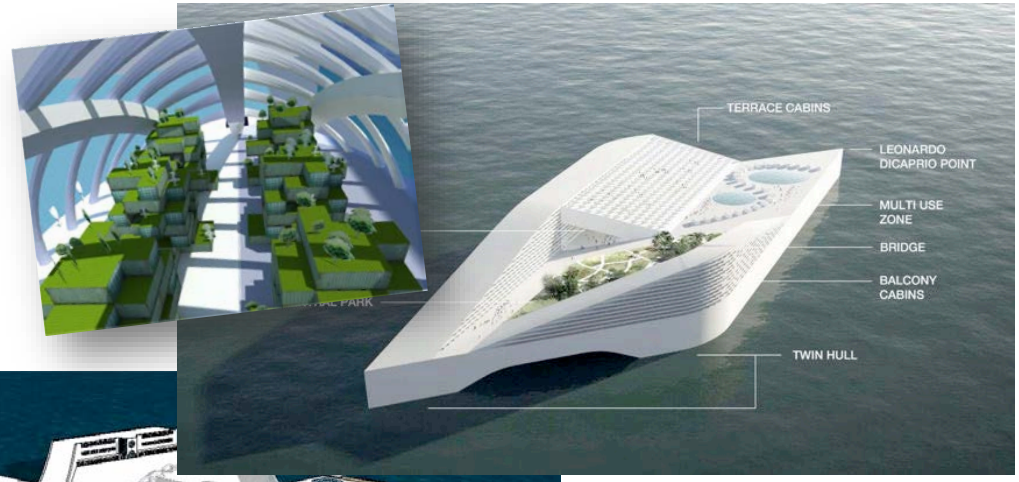


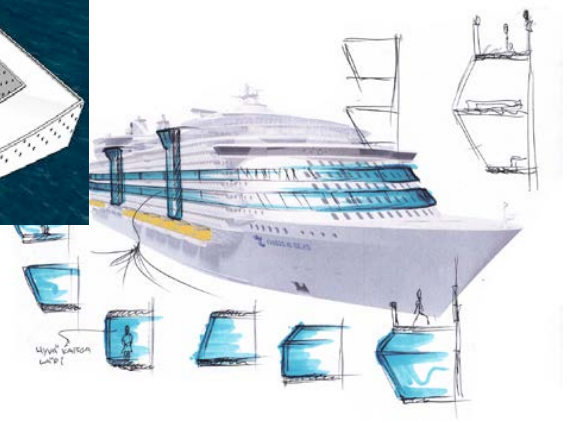


…useita diplomitöitä 90-luvulla kehitystyöhön liittyen

Cruise and Ferry: esimerkkejä motivoitujen opiskelijoiden näkemyksistä tulevaisuudesta







Interlinked M.Sc. Theses (Kolmen kopla)

- Advanced learning process in naturally multidisciplinary environment
- High level applied research between technology, design & economy in passenger ship context
- Awards winning joint Master theses project *(2010, 2013)*

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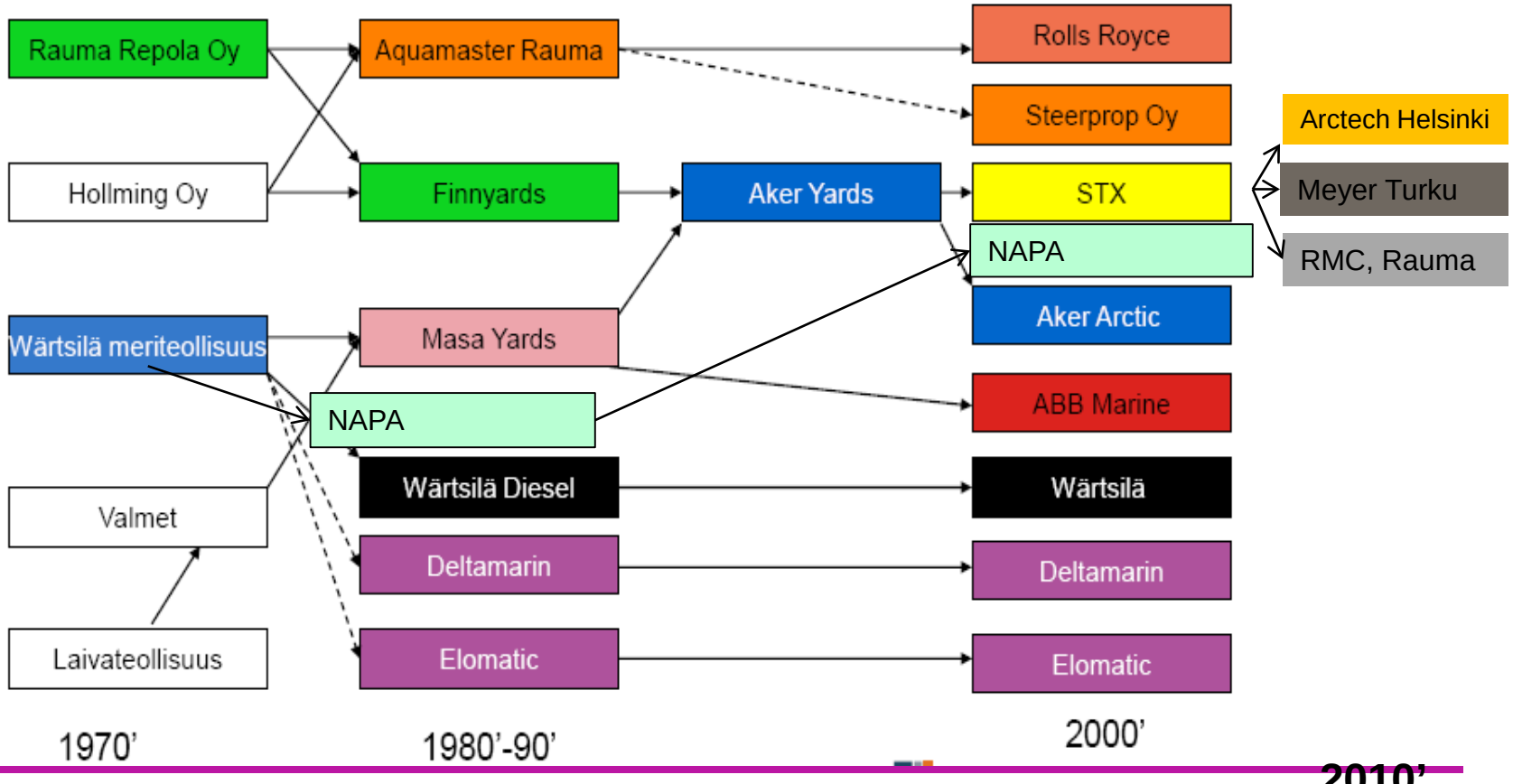
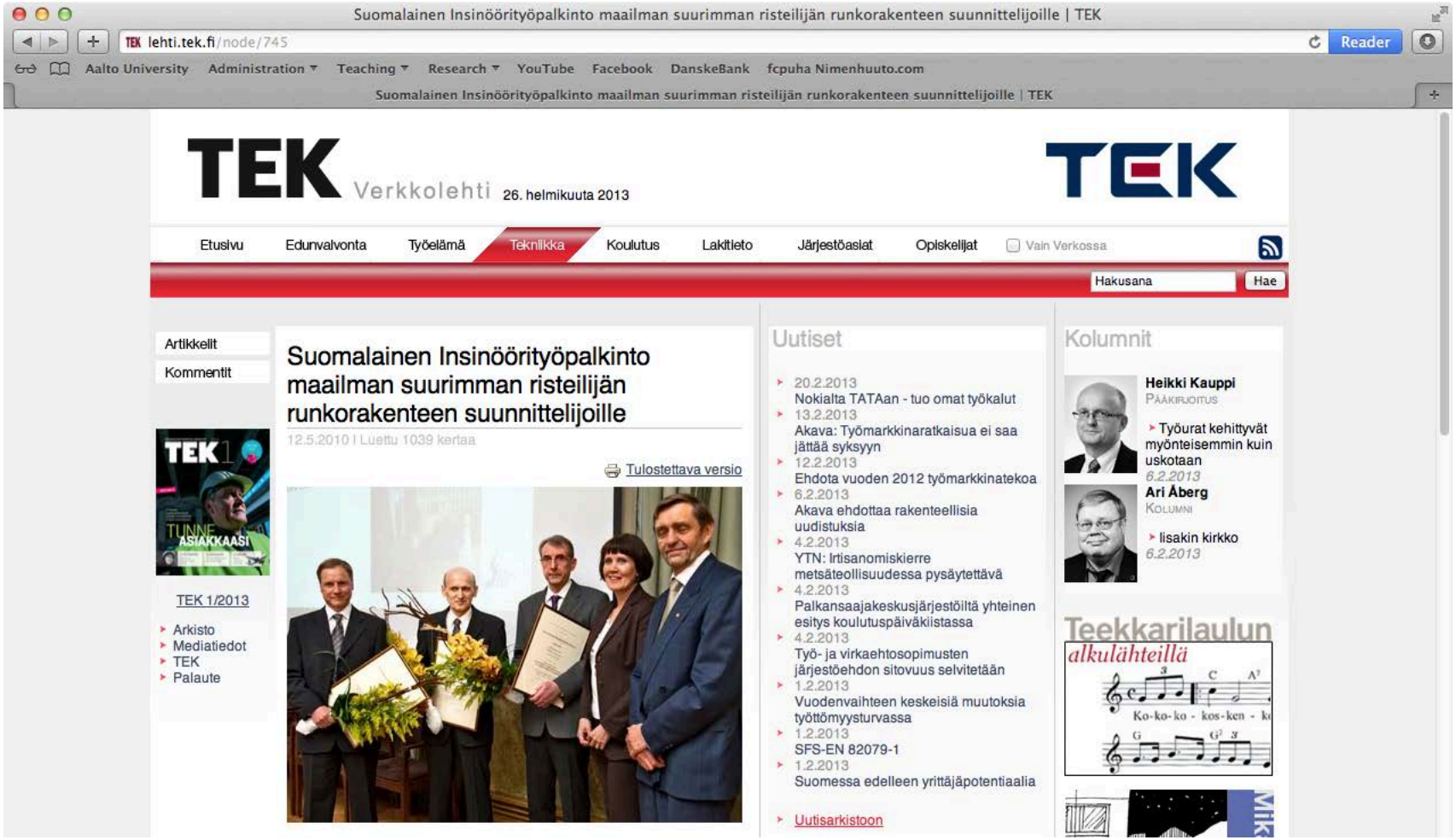
School of Engineer

Business world dynamic, but wordclass competence is the only permanent success factor



Alumnit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Edunvalvonta
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Tekniikka
Koulutus
Lakitieto
Järjestöasiat
Opiskelijat
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Ehdota vuoden 2012 työmarkkinatekoa
6.2.2013
Akava ehdottaa rakenteellisia uudistuksia
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YTN: Irtisanomiskierre metsäteollisuudessa pysäytettävä
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Palkansaajakeskusjärjestöiltä yhteinen esitys koulutuspäiväkiistassa
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Työ- ja virkaehtosopimusten järjestöehdon sitovuus selvitetään
1.2.2013
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1.2.2013
Suomessa edelleen yrittäjäpotentiaalia
Uutisarkistoon
Kolumnit
Heikki Kauppi
Pääkirjoitus
Työurat kehittyvät myönteisemmin kuin uskotaan
6.2.2013
Ari Åberg
Kolumni
Iisakin kirkko
6.2.2013
Teekkarilaulun
alkulähteillä

Kiitos!