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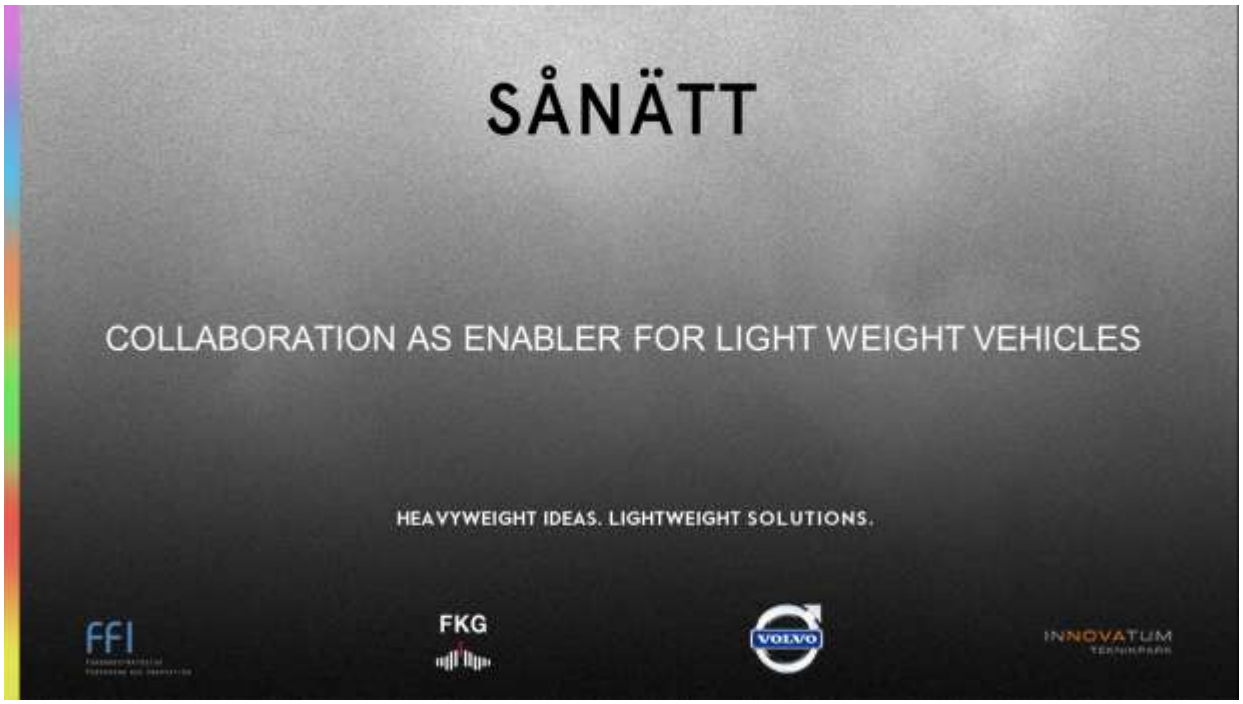
SåNätt : Collaboration as enabler for light weight vehicles



Project : 2012-00878 Collaboration as enabler for light weight vehicles

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FFI in short

FFI is a partnership between the Swedish government and automotive industry for joint funding of research, innovation and development concentrating on Climate & Environment and Safety. FFI has R&D activities worth approx. €100 million per year, of which half is governmental funding. The background to the investment is that development within road transportation and Swedish automotive industry has big impact for growth. FFI will contribute to the following main goals: Reducing the environmental impact of transport, reducing the number killed and injured in traffic and Strengthening international competitiveness. Currently there are five collaboration programs: **Vehicle Development, Transport Efficiency, Vehicle and Traffic Safety, Energy & Environment and Sustainable Production Technology.**

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For more information: www.vinnova.se/ffi

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1. Executive summary

SåNätt aimed to find alternative approaches to more efficiently develop components, systems and complete vehicles. The background to the project was Saab Automobile's new situation as an independent car manufacturer. To cope with the task of developing competitive cars and its components new approaches needed to be explored. The aim was to utilize the combined expertise of the OEM (initially Saab and thereafter Volvo Cars), suppliers and academia in collaboration and thereby create greater efficiency.

The project brought together a total of approximate 40 partners from all levels of the supply chain, including OEMs and seven academic partners. The focus area of the project was lightweight design where the specific goal was to create a car in Volvo V60 size but with cost-effective weight reduction of 20-40% and a potential introduction in 2020+.

Several senior researchers from the project's academic partners were commissioned to produce a creative work environment and facilitate the project through a systematic approach where the individual and collaborative skills were utilized to create innovative design solutions that met the project's weight and cost targets.

The project worked in seven different balanced work teams with different design areas in focus - seat, chassis, underbody, roof, door, cockpit and complete vehicle. The project management ensured that the teams consisted of a mixture of different competences from OEMs, academia and suppliers which all had an equal weight in the group.

Development took place in six phases - concept generation, value driven design, systematic design, idea-to-innovation and making business together. Additionally, the team’s dynamic efficiency was "monitored" of a social psychologist. Each phase was facilitated by senior researchers from the different academic partners. The starting point was to release all the teams from traditional restrictions of interfaces and requirements and involve all parties from day one. Thereby creating conditions to revolutionize design solutions in contrast to evolutionary changes.

Through a systematic approach, creative work environment and balanced work teams all teams managed develop lightweight solutions that exceeded the weight goal of the project - i.e., > 40% weight saving! Compiled into a harmonized car of V60-size with sustained properties the achieved weight saving was almost 40%.

The project has demonstrated the competence and capacity of the Swedish automotive industry!

2. Bakground

The SåNätt project was initiated in 2010 in conjunction when Saab Automobile went on to be an independent automakers released from General Motors.

An international company like GM works with global supplier that support GM 's global standardized production structures and a general approach where smaller suppliers are eliminated - including many of the Swedish . GM's main collaborations are with the major international Tier1 suppliers. These suppliers are often locked into heavy infrastructure investments which hinders implementation of innovative solutions. Moreover, much of the basic structure of the development work is done by the OEM and Tier 1 suppliers. When suppliers further down the chain becomes involved in the design, much of the design is locked and compromises becomes necessary to introduce in order to deliver to the already defined structure, interfaces and requirements.

With the size of the independent Saab, new work processes were required to develop competitive cars - and Saab could not do it on its own. The approach discussed was to initiate closer collaboration with suppliers. This would give that the suppliers would come in earlier in the development process and contribute with their expertise. At the same time the OEMs would focus on their specific skills, i.e. complete vehicle requirements and validation together with system integration. That would lead to that the specific skills of each partner would be used more effectively and more optimal design solutions could be developed. This is the theory that the project aimed to evaluate.

In connection with the bankruptcy of Saab, Volvo Cars took over the role as the OEM in the project. Volvo's situation was in many ways similar to that of Saab with the purchase of Volvo from Ford by Geely and Volvo's new more independent situation. This allowed Volvo to step into the role as an OEM for the project in a relatively simple way.

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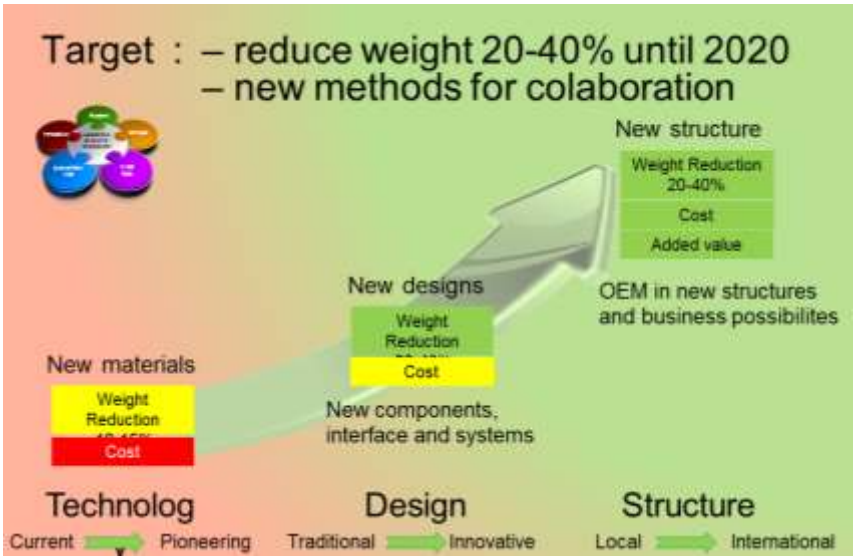
3. Objective

The project aimed to create opportunities for the Swedish automotive OEM which together with the Swedish suppliers would find new ways and technologies that would strengthen the Swedish automotive industry in the long term and increase the competitiveness in lightweight design by:

- ... improve cooperation between suppliers to create new solutions that increases competitiveness
- ... create new forms of cooperation between the OEM and suppliers in Sweden
- ... strengthen utilization of research findings in Swedish industrial projects
- ... find newly developed technologies and innovations for lightweight design within Swedish industry and research

As a specific measurable goal for the project the various teams would develop systems and concepts that should reach 20-40% cost-effective weight reduction to 2020+.



4. Project Realization

The project began with an open invitation to FKG 's member companies and academic partners to participate in a number of brainstorming workshops. The objective was to determine the interest in the project ideas and direction but more important to identify the wealth of ideas for lightweight solutions for suppliers and academia.

The workshops resulted in a wide range of ideas that could be clustered together into system areas for which the project would focus on - seats, chassis , underbody, cockpit, roof and door, as well as a complete car team . These areas evolved during the project based on the project's development. The complete car team had both the aim to identify conceptual solutions from a complete car perspective but also to coordinate the different team's work relating to, for example moving functionality from one traditional system area to another, supporting evaluation of requirements challenges and functionality integration.

The project partners then chose which areas they were interested in working with and this created the work teams (each team's partners are presented in the visualized images under chapter 5). The teams were balanced so that OEMs, suppliers and academia were equally represented - that no party had a dominant role in their respective teams. A team leader was chosen in each team and initially the role landed on a supplier. It was important not to choose an OEM representative for this role as it was deemed necessary to create a climate within the group where everyone's skills would be utilized.

The project was executed in six phases. Each phase was facilitated by senior researchers from different academic partners where systematic processes were utilized to take the project teams through every planned step.

The objective of the project management during the process was to get the team to remain in an innovative status and not fall back into traditional development practices.

Concept Generation– Dr. Lars Almefelt, Chalmers Tekniska Högskola

> Initially there was an idea generation phase where Dr. Lars Almefelt led the teams through a process utilizing each party's expertise to create individual ideas that solved the various functionalities of the design area. The ideas were created and then clustered into different concepts syntheses that became the basis for the different conceptual approaches.

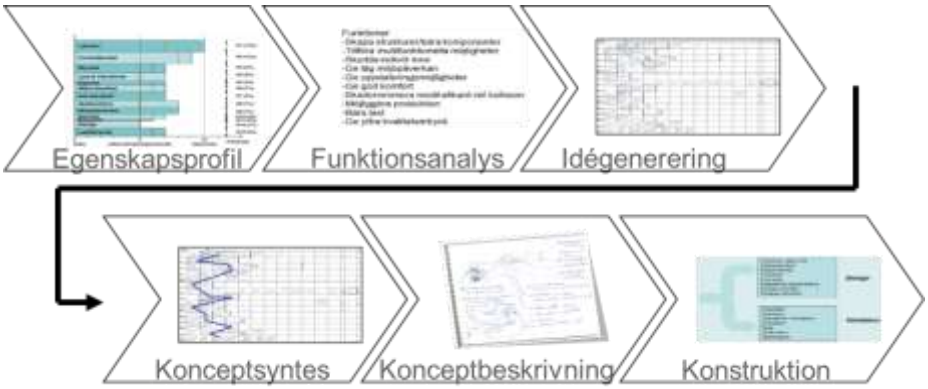
Value Driven Design – Dr. Mattias Bergström, Luleå Tekniska Universitet & Prof. Tobias Larsson, Blekinge Tekniska Högskola

> During this phase, all concept syntheses were evaluated from different perspectives in order to better understand and identify the true value of different conceptual solutions.

Based on the first two phases conceptual ideas were defined for each of the teams to move forward with the next phase.

Systematic Design – Dr. Anders Claesson, Chalmers Tekniska Högskola

This phase was the actual design and development phase. Dr. Anders Claesson task was to get the team to achieve what was defined as "slow development" with the goal to avoid getting into traditional solutions. The systematic approach worked structurally looping through the steps to evaluate, refine, iterate, reflect and mature to develop the innovative lightweight solutions.



Idea to Innovation – Massimo Panarotto och Prof. Tobias Larsson, Blekinge Tekniska Högskola

In too many cases, a good idea is prevented from becoming an innovation. The reasons for this are many. The objective of this phase of the project was that, in workshop format, to identify what can prevent the various concepts from passing the traditional obstacles.

Making Business Together – Prof. Magnus Klofsten, Linköpings Universitet

Linköping University was involved in the project to support in the commercial development of the concepts. The process that Prof. Magnus Klofsten executed

aimed to take the concepts from an idea platform to a business platform and create business-like buoyancy.

Group dynamic efficiency – Anni Tysk, Högskolan I Skövde

Anni Tysk, social psychologist, was involved early in the project when it was deemed necessary to watch over the efficiency of the teams as well as the project management. With so many different partners within the framework of the project the project management estimated that a complexity would arise. Anni supported the teams and the project to create an awareness and understanding of the mechanisms required for effective cooperation and an effective project.

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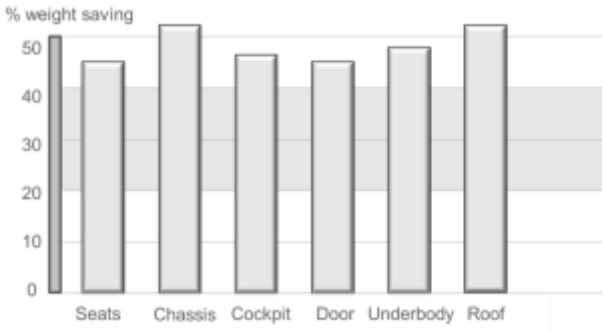
5. Results

The overall project objective was to reach cost-efficient weight savings of 20-40% with an implementation around 2020. The base was a car of Volvo V60 size with maintained functionality. The only deviation from the fundamental contents of a Volvo V60 was that the car consisted of four seats compared to five.

Each team managed to reach the weight goal and exceeded that goal too! Some teams more than halved the weight of their respective systems. In addition to the process that teams have worked by and the project structure the teams have reached the goals by:
- Efficient use of materials, process and joining technologies
- Functional Integration - example is exhaust system and tank integrated into the underbody
- Movement of certain features - such as are several features moved closer to the driver and passenger (speakers, heating and cooling)
- Reformulation of requirements (both legal and customer) – e.g. rear view mirrors have been replaced by cameras

The developed concepts were compiled into a virtual car where the weight was balanced by the new conditions. Weight reduction on the complete car was then almost 40% in a car with a traditional driveline.



The achieved weight reduction of each complete team an

Weight reduction of a fictive vehicle with a traditional driveline and example with a plug-in hybrid

Below are the visual images on the conceptual solutions that each team has developed.

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Description of the technical architecture and reasoning behind the team's concept is described further on the project website - www.sanatt.se.

MIWECO
CHALMERS
BENTELER ENGINEERING SERVICES

SEMCON
VOLVO CAR GROUP
MÜLLER-BBM
FKG

COMPLETE VEHICLE

FINNVEDEN METAL STRUCTURE
UNIVERSITY OF SKÖVDE
ARSIZIO
BORGSTENA GROUP
MIWECO

KONGSBERG AUTOMOTIVE
HAVD GROUP
PURTECH
RUUKKI
SEMCON

SEAT

SKF
EWES STÅLFJÄDER
UNIVERSITY WEST
VOLVO CAR GROUP

KTH – ROYAL INSTITUTE OF TECHNOLOGY
MIWECO
SEMCON

CHASSIS

STANLEY ENGINEERED STRUCTURES
KONGSBERG AUTOMOTIVE
IAC GROUP
SEMCON

UNIVERSITY OF SKÖVDE
FINNVEDEN METAL STRUCTURE
VOLVO CAR GROUP
3M

COCKPIT

VOLVO CAR GROUP
LAMERA
SAPA
SEMCON

GLAFO – THE GLASS RESEARCH INSTITUTE
IAC GROUP
TESA

DOOR

LAMERA
ARSIZIO
BENDIRO
BULTEN
DYNAMORE NORDIC
ESSVE PRODUKTER

KTH – THE ROYAL INSTITUTE OF TECHNOLOGY
GESTAMP
LULEÅ UNIVERSITY OF TECHNOLOGY
MÜLLER-BBM
PROFILGRUPPEN
VOLVO CAR GROUP

UNDERBODY

ACAB – APPLIED COMPOSITES
UNIVERSITY OF SKÖVDE
VOLVO CAR GROUP
SEMCON
3M
GESTAMP

GLAFO – THE GLASS RESEARCH INSTITUTE
KTH – ROYAL INSTITUTE OF TECHNOLOGY
LAMERA
OXEON
SWEREA-SICOMP

ROOF

5.1 Delivery to FFI-goals

FFI program and its sub-programs have several goals. The SåNätt project has contributed to a large number of these objectives by:

- identifying conceptual solutions which reduced the weight of a Volvo V60 with up to 40% , contributing to meeting energy and environmental targets
- creating new forms of collaboration and partnerships between OEMs , suppliers and academia and increasing competitiveness on knowledge-based production in Sweden .
- demonstrating the competitiveness automotive industry in Sweden
- increasing the competence of suppliers complete vehicle development, development processes and lightweight design
- enhancing the understanding of R&D activities of many participants
- enhancing the understanding of critical research areas in product development and lightweight design
- strengthening research and innovation environments in the participating parties
- implementing research results from the academic partners in the project - both process-related and even technical areas such as materials , processes, jointing and calculation methodologies
- strengthening the collaboration between the automotive industry and government agencies, universities and research institutes
- supporting in national knowledge development in critical areas

6. Dissemination and publications

6.1 Knowledge and results dissemination

The SåNätt project chose to approach the summary and dissemination of results in a different manner than traditionally. Instead of compiling the results in report form the project management chose to visualize of the results in terms of different forms of marketing technologies. The dissemination results of the project were collected within the work team "Showroom".

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The various media that were utilized:

- **Webpage** (www.sanatt.se) which is a compilation and presentation of the project as a whole and the individual teams and their results.
- **Films :** All teams created a film where the teams' thoughts and reasoning behind developments and concepts are presented.
- **Prototypes :** Each team made demonstrators of their concepts , either as full-scale demonstrator or scale models that visualize the conceptual solutions that are used to reach weight goals.
- **APP :** The website has been reflected in an APP available on both iOS and Android. APP also includes the AR- developed models.
- **Exhibition :** In project ending in June 2013 an exhibition and presentation was organized. Present at the exhibition were key people from each party and government entities. An open presentation was also conducted
- **Broschure :** A promotional brochure was produced with the presentation of the project, the process and the various teams' work and achievements.
- **Augmented Reality :** AR is a powerful tool to visualize and explain the concept in a promotional manner. Each team developed was his AR- model.

APP

WEB PAGE

BOOKLET

SHOW ROOM

EXHIBITION

HARDWARE

AUGMENTED REALITY

FILM

6.2 Publications

- **Enhancing supply chain collaboration in automotive industry by value driven simulation,** Massimo PANAROTTO, Blekinge Institute of Technology, Tobias C. LARSSON Blekinge Institute of Technology , Andreas LARSSON Lund University, International Conference on Engineering Design13, 19-22 August 2013, Sungkyunkwan University, Seoul, Korea

7. Conclusions and future research

One of the basic objectives of the project was to demonstrate the skills and strength of the Swedish automotive industry (OEMs , suppliers and academies) holds . The project has clearly shown that under the proper prerequisites truly innovative solutions can be developed.

Henceforth, most of the concepts developed in the project are under further development to achieve a higher level of readiness, with the potential for implementation in future products.

Several of the project partners have jointly filed patent applications on multiples of the conceptual solutions developed within the project.

Some formations consisting of project partners have started collaborations entirely outside SåNätts framework.

The main results from SåNätt project is

- The effect of the collaboration in a creative and open environment
- The established networks between the project partners at all levels, OEM - supplier, supplier - academy , supplier - supplier . These networks will result in both product development projects and future research
- Experience and understanding of suppliers and academies in vehicle development
- Innovative lightweight designs

Based on the results from SåNätt there is a strong drive to initiate a "SåNätt II " with a focus on the collaborative effect. Discussions are underway to characterize the

direction and focus of a continuation. A project application is expected to be submitted in the spring of 2014.

8. Participating parties and contact person

The particpants of project gathered at the final project meeting and exhibition in Gothenburg in June 2013

3M
ACAB - Applied Composites
Arsizio
Bendiro
Benteler Engineering Services
Blekinge Institute of Technology
Borgstena Group Sweden
Bulten
Chalmers University of Technology
DYNAmore Nordic
ESSVE Produkter
EWES Stålfjäder
Finnveden Metal Structures
FKG - Scandinavian Automotive Supplier Association
Gestamp
Glafo - the Glass Research Institute
HAVD-Group
IAC Group Sweden
Innovatum
Kongsberg Automotive
KTH - Royal Institute of Technology
Lamera
Luleå University of Technology
Miweco
Müller-BBM Scandinavia
Oxeon
ProfilGruppen Extrusions
Purtech
Ruukki Sverige
SAPA
Semcon Caran
SKF
Stanley Engineered Fastenings
Swerea-Sicomp
tesa
University of Linköping
University of Skövde
University West
Volvo Car Group

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Contact persons

Anders Holmkvist	(Project Manager), EELCEE AB, 0708-101632, anders.holmkvist@eelcee.com
Stefan Svedhem	(Project owner and coordinator), Innovatum AB, 0520-299328. stefan.svedhem@innovatum.se
Axel Edh	Volvo Car Group, 031-3259834, axel.edh@volvocars.com

For more information

Project web page :	www.sanatt.se
Team and project films **:**	www.youtube.com/channel/UCdLW9MUyLFVhBCIYph0Cglw
Photos from exhibition :	plus.google.com/photos/113291587792983061217/albums/5894641884951363809?banner=pwa&authkey=CJW-zrXFhaj17AE