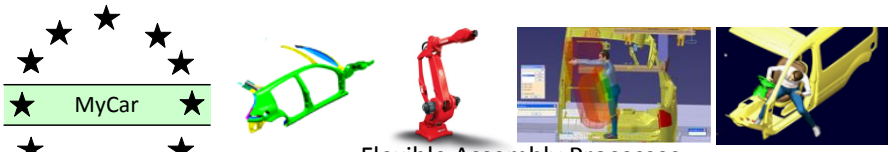
MyCar

Flexible assembly processes for the car of the third millennium



Flexible Assembly Processes
for the Car of the 3rd Millennium

From single model production line …

…to multi-model production line

Long term sustainability of EU vehicle manufacturing considering the customer as the core element, offering personalisation to achieve market differentiation against non-EU competitors.

From traditional mass production plants…

...to self adaptive production plant

VOLVO DAIMLER Ford CRF CENTRO RICERCHE FIAT LMS

EDAG TÜNKERS Erfindergeist serienmäßig. COMAU PRIMA INDUSTRIE HWH

emphasis TELEMATICS SIEMENS CASP cenit

UNIVERSITÄT DES SAARLANDES KIT Karlsruher Institut für Technologie UNIVERSITY OF SKÖVDE CHALMERS

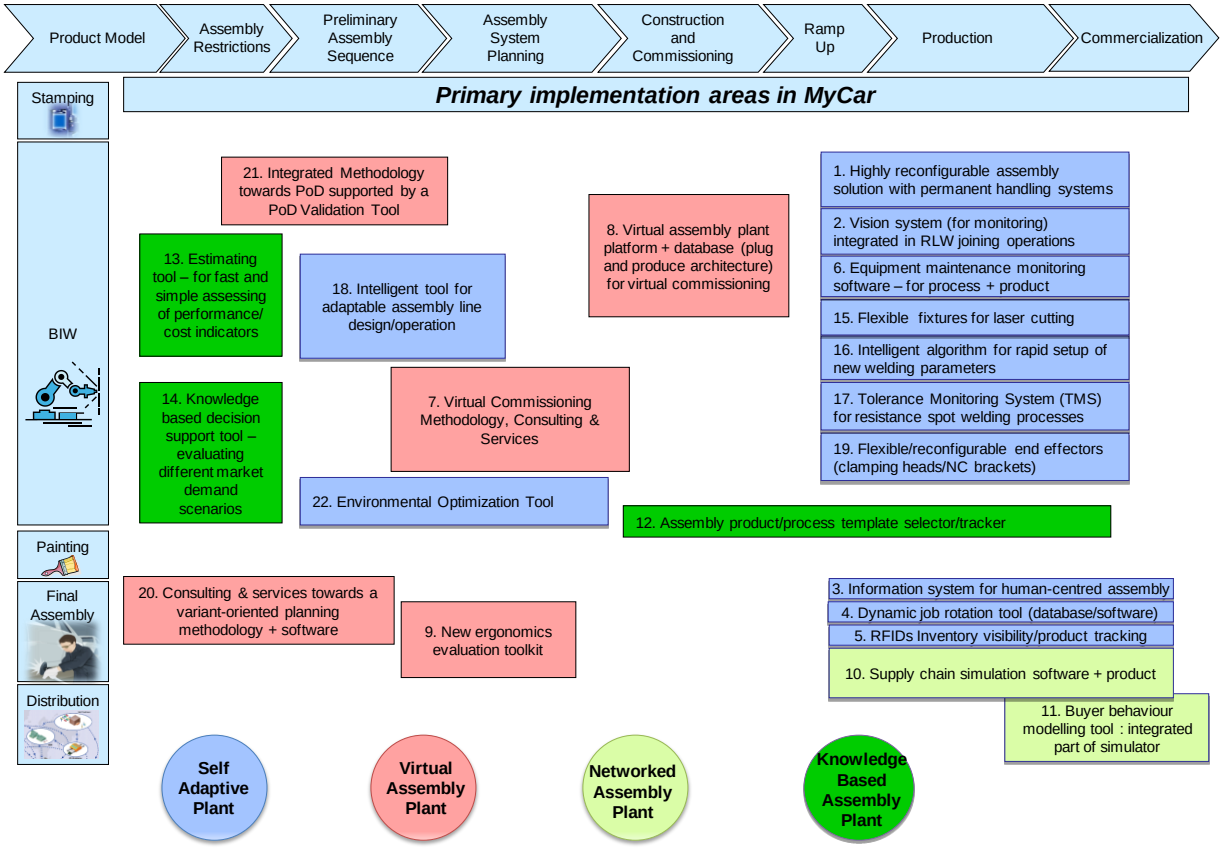
MyCar Objectives

Customer orientation

Production flexibility

Industry sustainability

MyCar Integrated Suite



Project Coordinator
Bert Hill
Volvo Technology
Dept. 6340 M1.4
SE-405 08 Göteborg, Sweden
Tel. +46-31-322 7483
Email: bert.hill@volvo.com

Project Manager
Dr. Sotiris Makris
Laboratory for Manufacturing Systems and Automation
Director: Prof. George Chryssolouris
University of Patras, 26500, Greece
Tel.: +30-2610-997262
Email: makris@lms.mech.upatras.gr
http://www.lms.mech.upatras.gr

MyCar

Flexible Assembly Processes for the Car of the Third Millennium

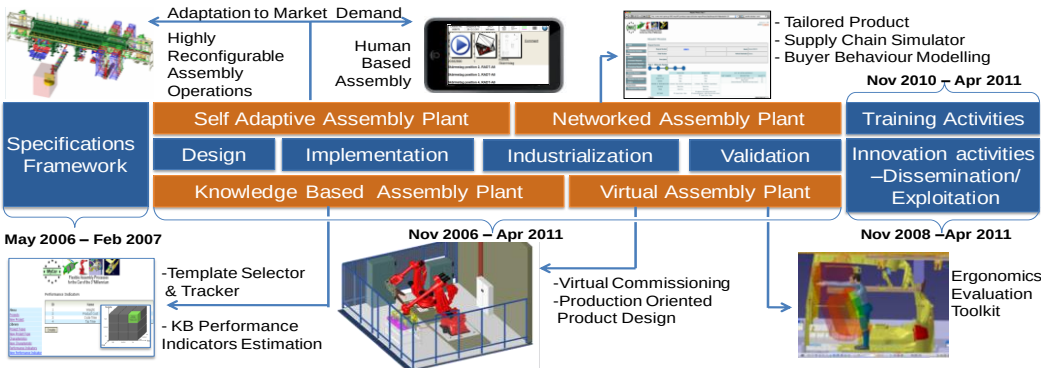
MyCar overall

Motivation and Objectives

MyCar envisions long term sustainability of EU vehicle manufacturing considering the customer as the core element, offering personalization to achieve market differentiation against non-EU competitors.

Project Plan, Milestones and Deliverables

The figure conveniently summarizes the major results of the main MyCar subprojects:



Solution and concept

- **Enhancing production flexibility**/ increasing number of models produced in a single line - flexible assembly equipment and human operators to easily adapt to market variations.
- **Shorter ramp up times** - virtual validation of production using realistic model of actual production – Advanced human ergonomics simulation.
- **Supply chain flexibility** - enhanced supply chain communication flows to enable real time decisions.
- **Closing the loop between production & design** - shorten product/process implementation time.

Realization

Twenty-two exploitable results, demonstrated in physical and virtual pilots, two of which are the following:

- **Flexible testbed** with cooperating robots able to assemble scalable products with variability in materials combination (RFID enabled).
- **Operator support system**. Automatic identification of products and operators and provision of information at the right place, at the right time and in the right manner (Volvo Trucks Pilot Case).

Organisational Information

Budget:	9.6 M€
Duration:	60 months
DG / Unit:	Research
Project Coordinator:	Mr. Bert Hill, VOLVO
Project Management:	Dr. Sotiris Makris, LMS
Website:	www.mycar-project.eu

Funding:	6 M€
Start:	May 2006
Contract n°:	NMP2-CT-2006-026631
Contact:	bert.hill@volvo.com
Contact:	makris@lms.mech.upatras.gr

MyCar

Result 1: Highly Reconfigurable Assembly Solution with Permanent Handling Systems

Flexible Assembly Processes for the Car of the 3rd Millennium

Self-adaptive assembly plant

Motivation and Needs

In the actual economic contest, car manufacturers require an improved **flexibility** of the production plant in order to quickly react the market variations, due to customers requests of new products. In this scenario, the chassis is the main part of a vehicle affected by the aesthetical changes. As a consequence of this flexibility, a **new production concept** must be envisaged, requiring the integration of several technologies.

Solution and Concept

A New Production approach

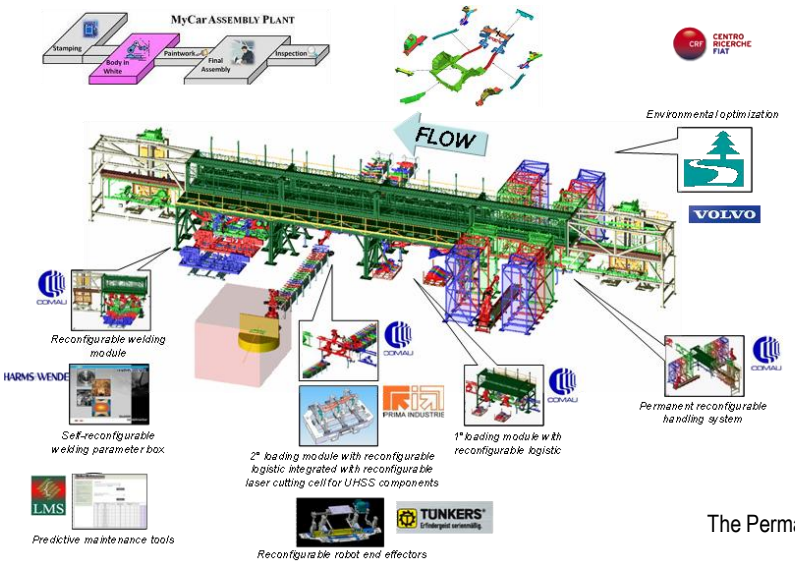
from today robotic model depending equipment ….

… to reconfigurable Bodyshop based on **model INDEPENDENT solutions**…

Future Bodyshops Requirements:

- Need to reduce complexity.
- Increase the available work time for value added equipment.
- Reduce the time it takes to do work (weld).
- Reduce, Communize, Simplify, and Eliminate non value added equipment.

Realization



The Permanent Reconfigurable Handling System

Area of Application

MyCar applied this exploitable result in the Body in White production area, with the perspective that it could be extended also to the Final Assembly or Painting area.

- Production flexibility, up to 5 models in the same body shop line.
- Higher efficiency.
- Full utilization of equipment.
- Utilization at plant level by 10-15%.
- Integration of non robotic reconfigurable equipment solutions.

+

- Energy consumption.
- Investment costs and Running costs over plant lifespan.
- Maintenance requirements.
- Time to market by 30%.

-

Contact Information

Exploitation Leader:	Dott. Ing. Valeria Serpi, COMAU	Contact:	valeria.serpi@comau.com
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	CRF, PRIMA, TUENKERS, LMS, H&W		
Website:	www.mycar-project.eu		

VOLVO DAIMLER Ford CRF CENTRO RICERCHE FIAT LMS EDAG SIEMENS COMAU Sixth Framework Programme

CHALMERS KIT UNIVERSITÄT DES SAARLANDES UNIVERSITY OF SKÖVDE HWH PRIMA INDUSTRIE TUNKERS CASP cenit emphasis

MyCar

Result 2: Vision System for Robotic Welding

Flexible Assembly Processes for the Car of the 3rd Millennium

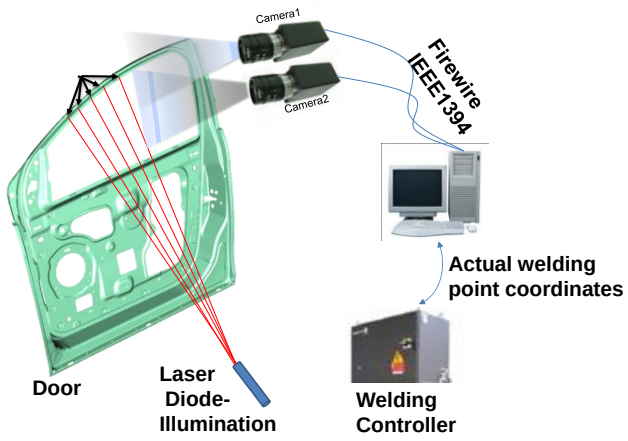
Self-adaptive assembly plant

Motivation and Needs

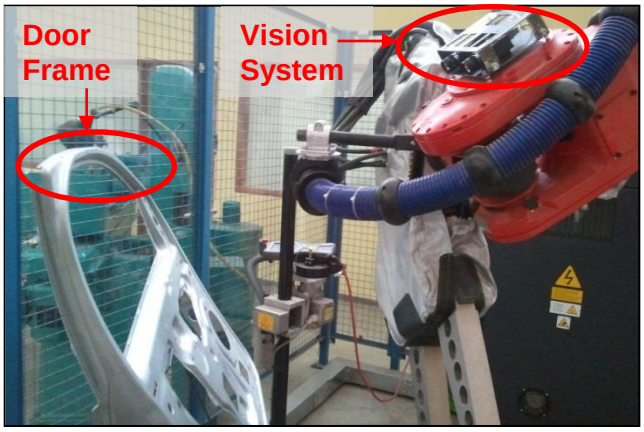
- The need to reduce part weight and enhance aesthetics can be achieved by reducing flange size; this implies the need for systems to ensure accuracy during the operation.
- Part dimensions may vary due to the production process, therefore compensation is needed for achieving high weld quality.
- Low cost and fast elaboration vision system for wide range online real-time monitoring applications.

Solution and Concept

- Stereo vision concept for 3D application.
- Use of laser projected beams to highlight welding points and solve the correspondence problem.
- Cameras mounted on robot to avoid interference to the process.



Realization



Area of Application

- MyCar applied this exploitable result in the assembly of a vehicle door using spot welding.
- The benefits involve:
  - Simple and low cost (one order of magnitude lower than current SoTA).
  - Reconfigurable solution that can be applied to different sets of geometries (parts).
  - Fast processing time relatively to the existing systems.
  - Generic method that can be applied to different processes (e.g. Remote Laser Welding).

Contact Information

Exploitation Leader:	Mr George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	VOLVO, CRF, LMS, CASP		
Website:	www.mycar-project.eu		

MyCar

Result 3: Information System for Human-Centred Assembly

Flexible Assembly Processes for the Car of the 3rd Millennium

Self-adaptive assembly plant

Motivation and Needs

- Volvo Trucks' plants produce very customised products to satisfy different customer needs. The complexity of products creates difficulties for operators when assembling different variants.
- There is a need for effective tool to support operators in managing variation and thus decrease the number of undetected quality defects during assembly.

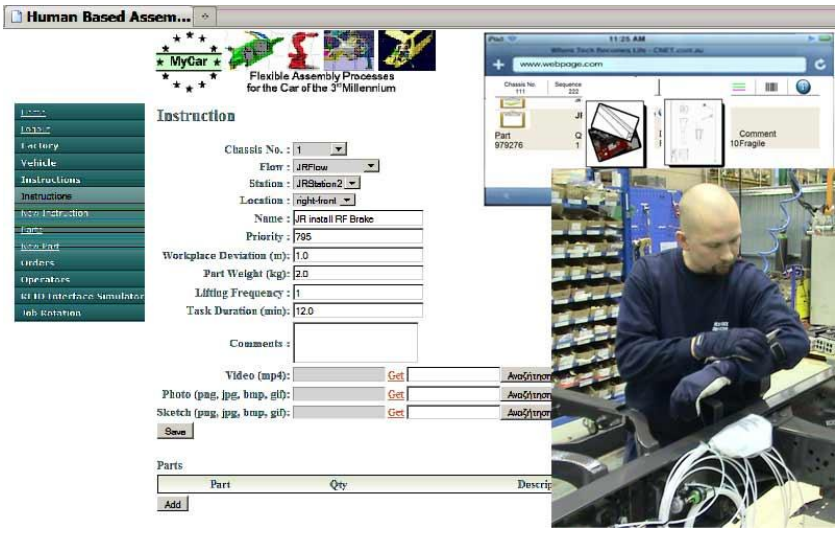
Solution and Concept

Information system for providing assembly instructions.

- Mobility of assembly information using mobile wireless devices.
- Assembly instructions in multiple formats (drawings, videos, photos etc.).
- User centred interface that reduces effort to retrieve and understand instructions .



Realization



Area of Application

MyCar has applied this exploitable results in the final assembly processes and the expected benefits are:

- Increased mobility of operator using the information system, allows greater freedom of work.
- It saves time and reduces unnecessary workload; it also means that there is no delay between looking up the information and using it for the task at hand.
- If further information is needed during the execution of the task, the operators are more likely to look up this information (instead of just "guessing").

Except for the assembly processes, there is a potential that it can be applied in the supporting processes such as logistics and maintenance. Work assignments in logistics and maintenance areas are quite often multi-task related, which is similar to the assembly processes.

Contact Information

Exploitation Leader:	Dr. Thomas Lezama, VOLVO	Contact:	thomas.lezama@volvo.com
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	VOLVO, CHALMERS, UNISKOEVDE		
Website:	www.mycar-project.eu		

MyCar

Result 4: Dynamic Job Rotation Tool

Flexible Assembly Processes for the Car of the 3rd Millennium

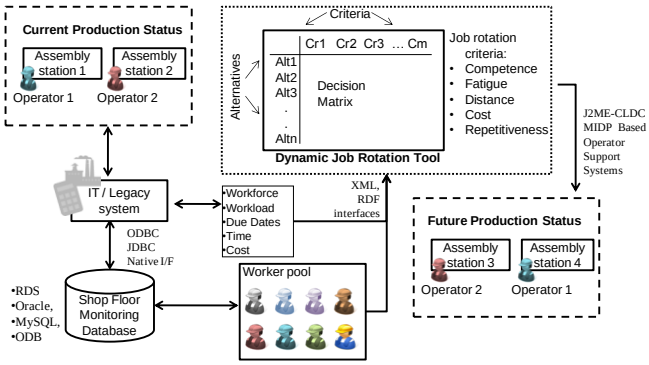
Self-adaptive assembly plant

Motivation and Needs

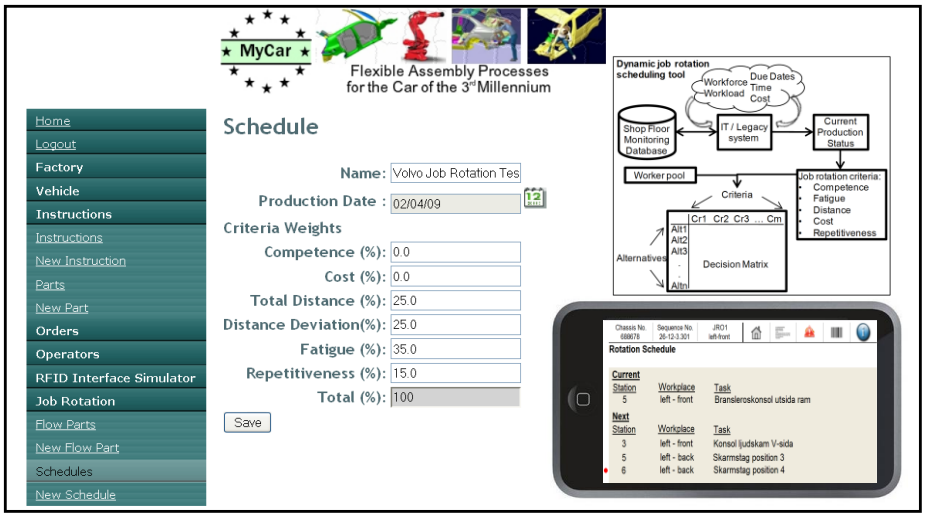
- Despite the technological advances that have allowed the automation of many assembly and manufacturing processes, **human operators remain a critical factor** in almost every assembly system.
- Human performance and error proneness is affected by three main factors: task characteristics, operator characteristics and work environment characteristics.

Solution and Concept

- Multiple criteria approach for calculating a job rotation schedule.
- Balances operator competence, cost, distance traveled, accumulated fatigue and repetitiveness of tasks.
- Web based application integrated with the ER 3 - Operator support system via mobile devices for direct operator access.



Realization



Area of Application

- MyCar applied this exploitable results in the Final assembly and in the Lifecycle stage of Operation.
- The expected benefits are:
  - Enables allocations of tasks over time that leads to a smoothened workload distribution.
  - Adaptation to schedule disturbances by fast and efficient reallocation of operators.
  - Multi skilled operators can effectively replace their colleagues in case of unexpected events (injury, absence).
  - Operators that rotate within a logical frequency tend to avoid the effects of monotonous work and are more alert when switching between tasks.

Contact Information

Exploitation Leader:	Mr George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	VOLVO, CRF, LMS, CASP		
Website:	www.mycar-project.eu		

MyCar

Result 5 : RFID Inventory Visibility and Product Tracking

Flexible Assembly Processes for the Car of the 3rd Millennium

Self-adaptive assembly plant

Motivation and Needs

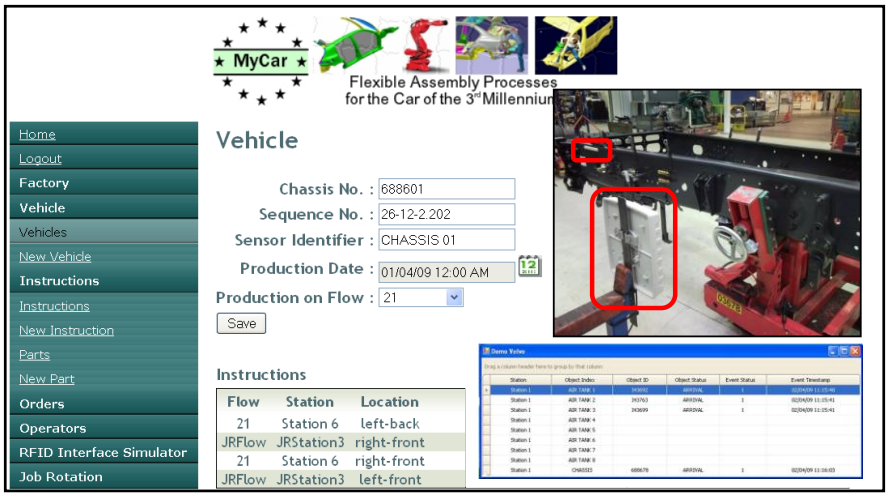
My Car aims at enabling the production of vehicles with extended degree of personalization. By automating the product, part and operator identification processes, operators can decrease the time needed for information management and reduce human errors during the assembly.

Solution and Concept

The RFID based inventory visibility/product tracking system, automatically trace assembly parts, assembly tools and operators and contributes to:

- - Support operators in managing variation – Reduce non added value activities.
- - Reduce assembly time and cost.
- - Decrease the number of undetected quality defects during assembly.

Realization



Area of Application

The RFID inventory visibility/product tracking system, has been developed and implemented under MyCar project. The solution adapted to chassis and air-tank identification has been installed successfully in the air-tank assembly cell at VOLVO Tuve plant.

The solution is adaptable to a broad range of human based manufacturing activities within and in between assembly cells. Furthermore can be integrated with other operational IT tools, like the Dynamic Job Rotation Tool implemented under MyCar.

The solution includes innovative aspects for automatic operator profiling and event generation when RFID objects are identified. The key improvement factors are:

- Short part identification time (approx 20msec).
- Possibility for multipart (>30) identification.
- Practically zero identification errors.

Contact Information

Exploitation Leader:	Dr. Giorgos Papapanagiotakis, EMPHASIS	Contact: gpap@emphasisnet.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact: bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact: makris@lms.mech.upatras.gr
Main Partners:	EMPHASIS, VOLVO, LMS	
Website:	www.mycar-project.eu	

MyCar

Result 6: Equipment Maintenance Monitoring Software for Process and Product

Flexible Assembly Processes for the Car of the 3rd Millennium

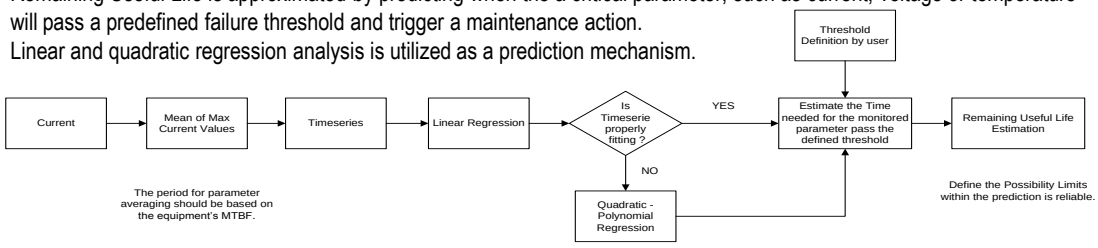
Self-adaptive assembly plant

Motivation and Needs

A holistic approach that includes the identification, the monitoring and the interpretation of the necessary parameters, fosters the maintenance-relevant information flow by predicting the failures and facilitates the management of resources and maintenance task execution. Therefore, contributing to the reduction of failures, increasing the efficiency of flexible assembly lines. The introduction of a measure to characterize the remaining useful life of an equipment assists the maintenance activities and increases the availability of the production lines.

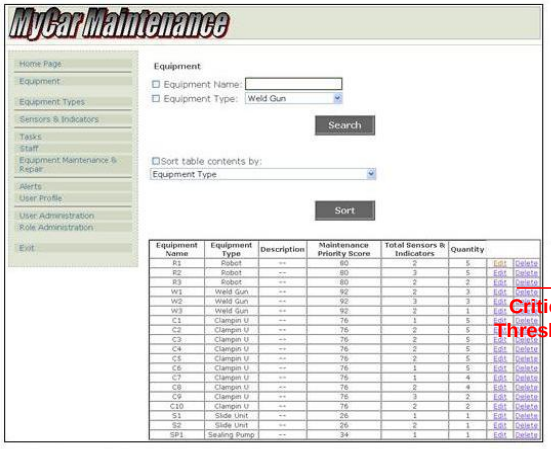
Solution and Concept

Remaining Useful Life is approximated by predicting when the a critical parameter, such as current, voltage or temperature will pass a predefined failure threshold and trigger a maintenance action.
Linear and quadratic regression analysis is utilized as a prediction mechanism.

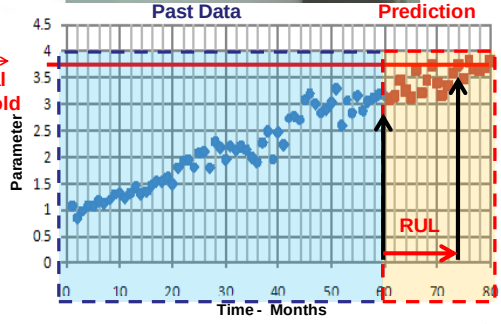


Realization

Clamping device installation



Equipment view



Remaining Useful Life Estimation

Area of Application

The equipment maintenance SW provides an estimation of the remaining useful life that assists the passage from scheduled maintenance to cost and time effective condition based maintenance. The current tool has analyzed current data from the Robotic Cell and a clamp. The benefits derived from the utilization of the tool can be the following:

- Reduce assembly costs up to 15%.
- Increase utilization at plant level by 10 -15%.
- Reduction of raw material consumption by 15%.

Contact Information

Exploitation Leader:	Mr George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	LMS, CRF, COMAU, TUENKERS		
Website:	www.mycar-project.eu		

MyCar

Result 7: Virtual Commissioning Methodology for Line and Cell Level, Consulting and Services

Flexible Assembly Processes for the Car of the 3rd Millennium

Virtual assembly plant

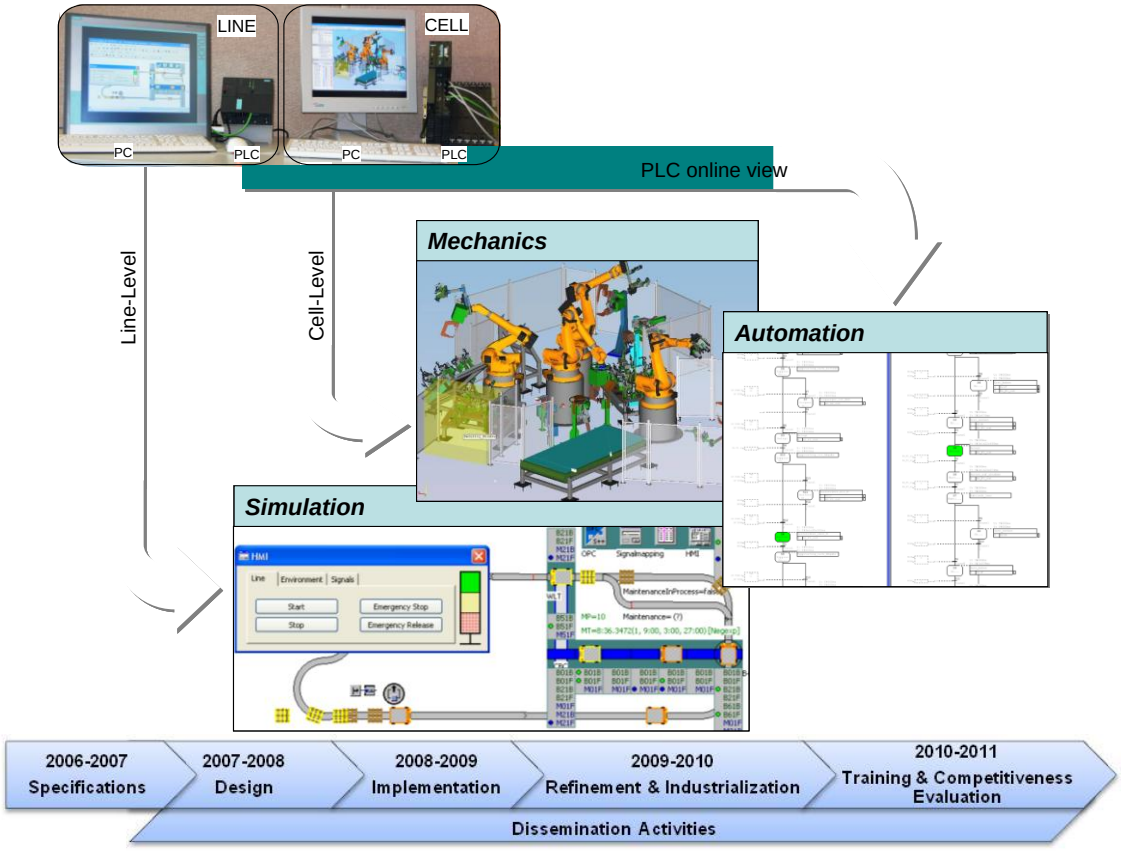
Motivation and Needs

MyCar (SP3) is focused on conceiving, designing and implementing a framework for virtual assembly platform. The line and cell level virtual commissioning contributes to following objectives:

- Reduction of investment costs by 20%.
- Shortening of ramp-up time by 20%.

Goal: Verification of mechanical behavior of the line in conjunction with PLCs in loop and the virtual commissioning of interacting production cells in a virtual line environment to enhance the maturity and quality of control engineering components prior to their real commissioning.

Solution and Concept



Realization

- Combined virtual commissioning of line and cell level completed.
- Guideline for modelling, processes and workflow for a tool independent VC available.
- Method for behaviour modeling to a standardized data exchange format contributed.

Area of Application

- Verification of PLC engineering in conjunction with the virtual line and cell.
- Provision of a basis for the optimization of lines and cells and for the verification of planned changes in a virtual environment without interrupting existing production.
- Description of a generic methodology to perform virtual commissioning of complex lines and cells.

Contact Information

Exploitation Leader:	Dr. Wolfgang Schloegl, SIEMENS	Contact:	schloegl.wolfgang@siemens.com
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	SIEMENS, EDAG		
Website:	www.mycar-project.eu		

MyCar

Result 8: Virtual Assembly Plant Platform

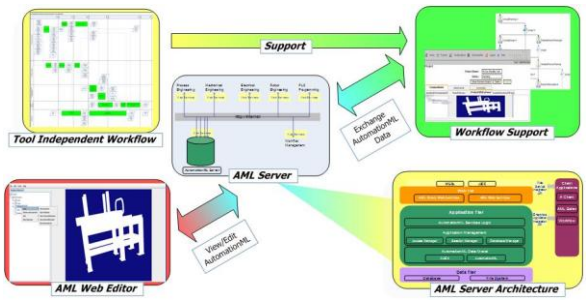
Virtual assembly plant

Motivation and Needs

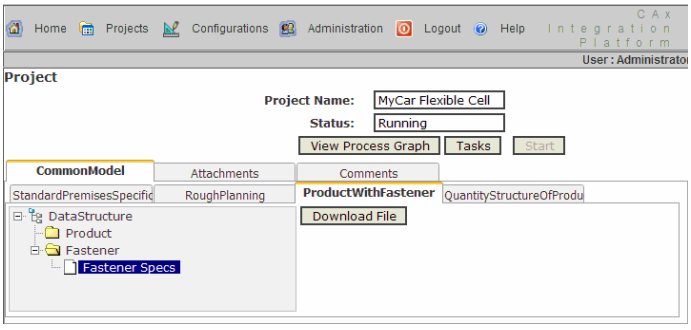
- Workflow management system for collaborative computer-aided production engineering in which Original Equipment Manufacturer (OEM) and supplier companies interact with the help of a diverse range of design and engineering tools.
- Provide a cross-tool communication platform.
- Complete representation of Virtual Plant in open data format.

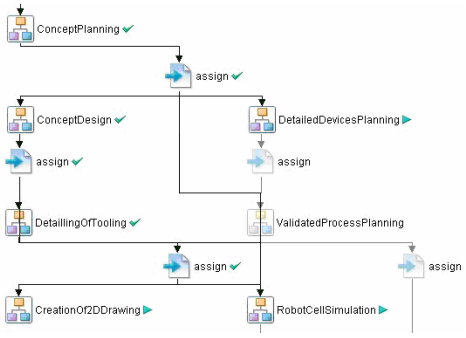
Solution and Concept

- A web-based workflow management system for integrated production engineering ahs been developed.
- The workflow of a production engineering project is configured within a BPEL Engine layer and deployed as a set of coordinated Web Services.
- The engineering data become available to the appropriate cooperating partners in native or AutomationML open format through the AutomationML Server. Virtual plant can be visualized though AutomationML viewer.



Realization





Area of Application

MyCar applied this exploitable results in trucks and passenger cars. The result was applied in virtual commissioning of an automotive assembly cell during the Lifecycle stage of Production Design.

The expected benefits are:

- Improved CAx interoperability.
- Saving of man-hours, due to an engineering activities coordination and automation by using the system.
- Complete representation of Virtual Assembly Plant in open data format.

Contact Information

Exploitation Leader:	Mr. George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	CASP, DAIMLER, SIEMENS, EDAG		
Website:	www.mycar-project.eu		

MyCar

Result 9: New Ergonomics Evaluation Toolkit

Flexible Assembly Processes for the Car of the 3rd Millennium

Virtual assembly plant

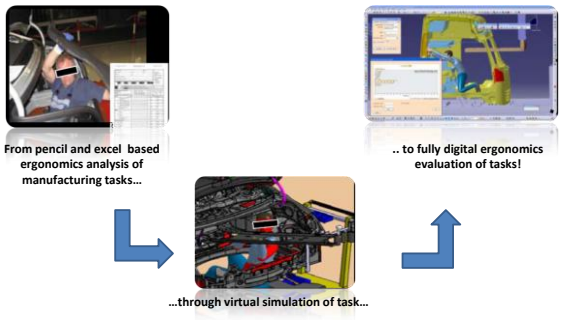
Motivation and Needs

- Efficient analysis of ergonomic factors in order to minimize or avoid injuries and safety problems.
- Improved assembly workplace design.
- Implementation in virtual manufacturing software of existing corporate ergonomics knowledge.
- Bring human factors assessment early in the design process in order to avoid costly changes at later stages.

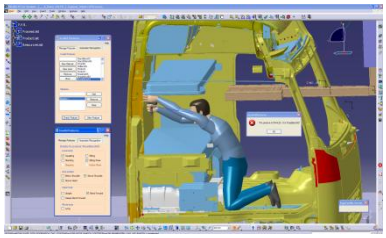
Solution and Concept

ErgoToolkit provides a range of digital tools for ergonomic assessment of human assembly tasks. ErgoToolkit has been developed in VB.NET and it is integrated with DELMIA V5 DHM.
The following tools have been developed:

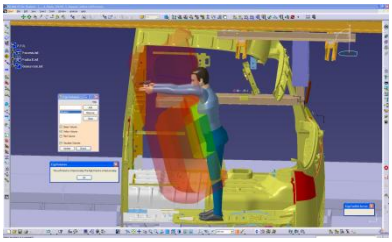
- Postures Definition and Recognition
- Ergonomic Volumes Recognition
- Stress Screening
- Dynamic Simulation



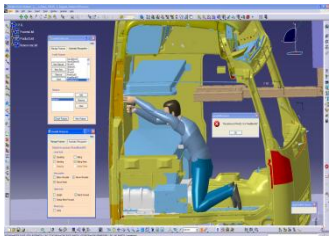
Realization



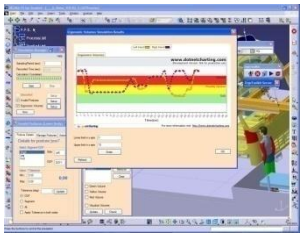
Postures Definition and Recognition



Ergonomic Volumes Recognition



Stress Screening



Dynamic Simulation

Area of Application

MyCar applied this exploitable results in trucks and passenger cars. The result was applied in the Final assembly and in the Lifecycle stage of Design.

The expected benefits are:

- Reduce assembly costs related to injuries of human that perform assembly tasks.
- Gain of time in ergonomics evaluation. Faster and easily-repeatable ergonomics analyses of the same tasks with different variants of the products.
- Improvement of ergonomics assessment process and better traceability of results; results can be documented in a standardized form.

Contact Information

Exploitation Leader:	Mr. George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	VOLVO, DAIMLER, LMS		
Website:	www.mycar-project.eu		

MyCar

Result 10: Supply Chain Simulation Software

Flexible Assembly Processes for the Car of the 3rd Millennium

Networked assembly plant

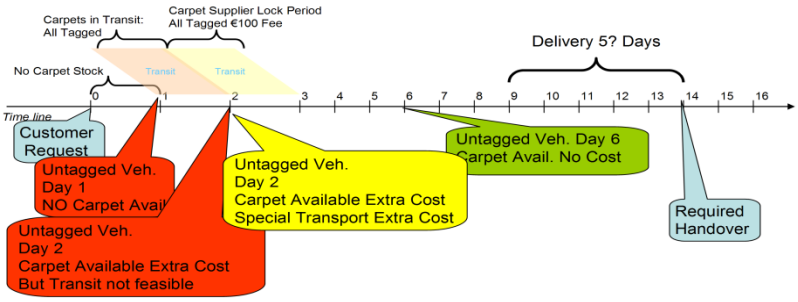
Motivation and Needs

- The requirement for producing highly customized products imposes the need for reconsidering the organizational structures and supporting them with advanced information technology.
- It is hard to evaluate the impact of the production schedule changes on the supply network.
- Late change in production schedule creates increased complexity in managing transportation.
- Logistics planning, in a flexible environment, requires an integrated and dynamic planning tool to dynamically control the supply network.

Solution and Concept

Develop a concept and a software model that:

- Simulates the impact of production change on suppliers.
- Calculates logistics lead time and cost associated with the production change.
- Considers supplier inventory, production capability and capacity constraints and confirmation of supplier ability to support the plan.



Realization

Area of Application

- MyCar applied this exploitable results in customising passenger vehicles and construction equipment. The result was applied in the Final assembly and in the Lifecycle stage of Operation.
- The expected benefits are:
  - Order to delivery time reduction.
  - Increase of matching produced vehicles to customer ordered vehicles.
  - Improvement of matching pre-ordered and pre-configured ordered products to actual customer requirements.

Contact Information

Exploitation Leader:	Mr. George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	FORD, CRF, VOLVO, LMS, CASP		
Website:	www.mycar-project.eu		

MyCar

Result 11: Buyer Behaviour Modeling Tool

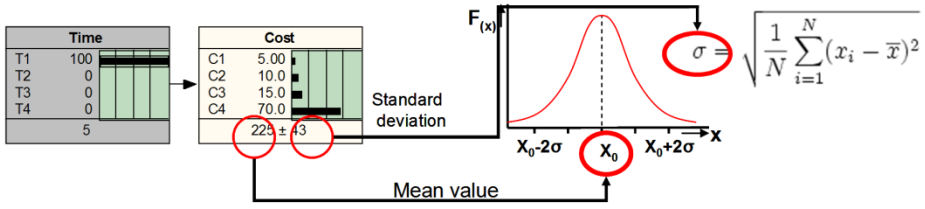
Networked assembly plant

Motivation and Needs

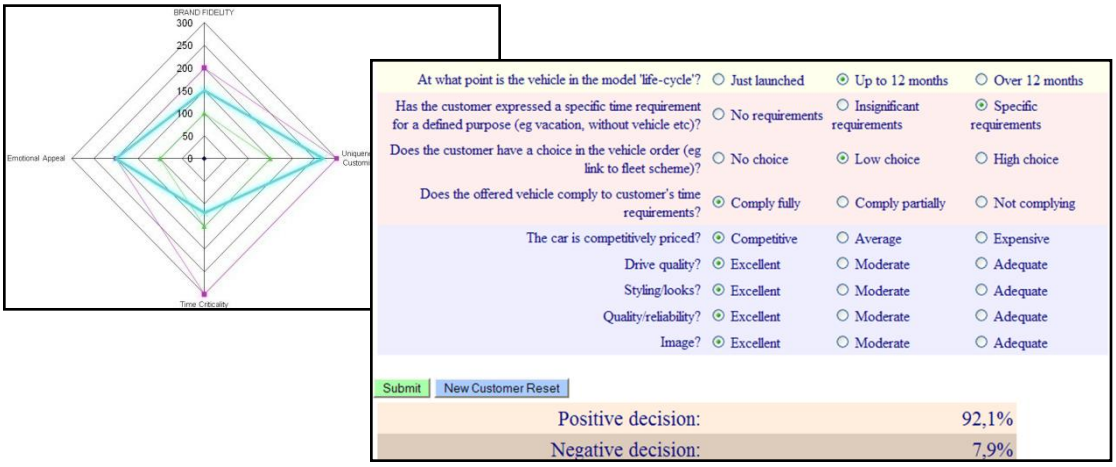
- In the mass customization approach, which aims to simultaneously target scores of individual customers by offering them product variations, tailored specifically to fit their individual needs, understanding customer behaviour under growing market stratification conditions is critical.
- It is essential to have an estimation of what the possibility will be as to whether the customer will actually place the order or he will withdraw it.

Solution and Concept

- A method of evaluating the probability that a customer, under a certain delivery time and price and given a set of factors, submits an order for a product.
- This tool quantifies the likelihood for a customer to place an order for a vehicle given a specific delivery date and customisation level.
- This is based on the Bayesian networks technique.



Realization



Area of Application

- MyCar applied this exploitable results in the Final assembly and in the Lifecycle stage of Operation.
- The expected benefits are:
  - Increase the matching of dealer orders to customer orders by helping the dealer provide the customer an appropriate delivery date.
  - Reduce time to delivery by providing to the proper customer the proper vehicle considering the customer's particular time requirements and desired customisation level.

Contact Information

Exploitation Leader:	Mr. George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	FORD, CRF, VOLVO, LMS, CASP		
Website:	www.mycar-project.eu		

MyCar

Result 12: Assembly Product and Process Template Selector and Tracker

Flexible Assembly Processes for the Car of the 3rd Millennium

Knowledge-based assembly plant

Motivation and Needs

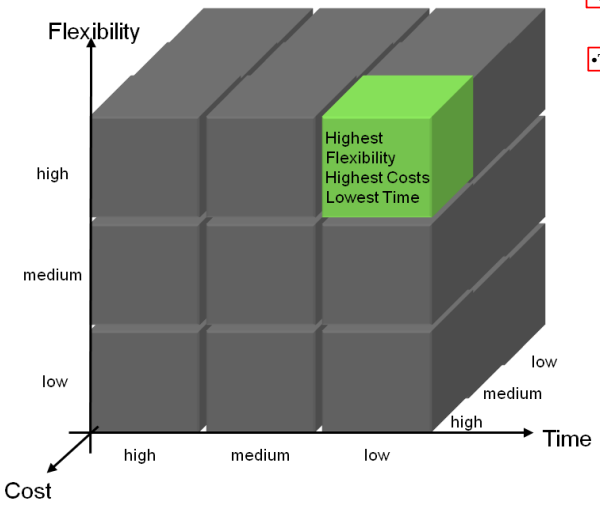
Knowledge of past products and processes is not or only partially reused when designing new products. Thus, methods for the classification and organization of the according manufacturing process and resource information are needed in order to be able to reuse already existing knowledge.

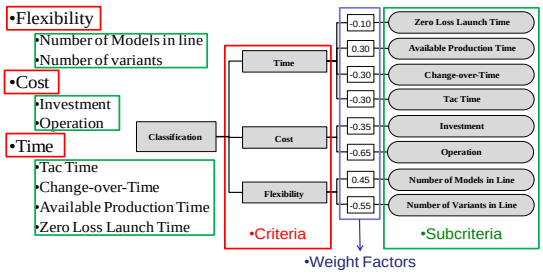
Solution and Concept

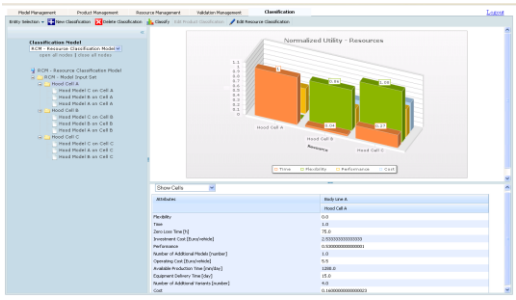
MyCar product and process template selector & tracker development aims to manage Process and Product Templates, taking into account flexibility issues, and allowing for the systematic organization and classification of the information; furthermore, tracking and capturing of all design and engineering changes taking place from the initial phase of the assembly line development till the commissioning phase. This is done by identifying for each of the criteria the influencing product, process or resource attributes. The categorization of past projects is done in one of 27 categories based on the calculated utility value of the criteria cost, time and flexibility. Innovative aspects include:

- Management and utilization of past accumulated know-how in new projects.
- Classification and categorization of available product and process templates with respect to the projected performance regarding new projects.

Realization







Area of Application

The present approach support the early design stages as well as advanced phases such as construction phase as well as production planning.

The development will sustain industrial progress by:

- Decrease of investment costs by 20%.
- Decrease of the number of undetected quality defects during assembly process by 15%.
- Shorten time to market by 15%.

Contact Information

Exploitation Leader:	Mr George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	CASP, CRF, EDAG, KIT, LMS		
Website:	www.mycar-project.eu		

MyCar

Result 13: Knowledge Based Performance Indicators Estimation Tool

Flexible Assembly Processes for the Car of the 3rd Millennium

Knowledge-based assembly plant

Motivation and Needs

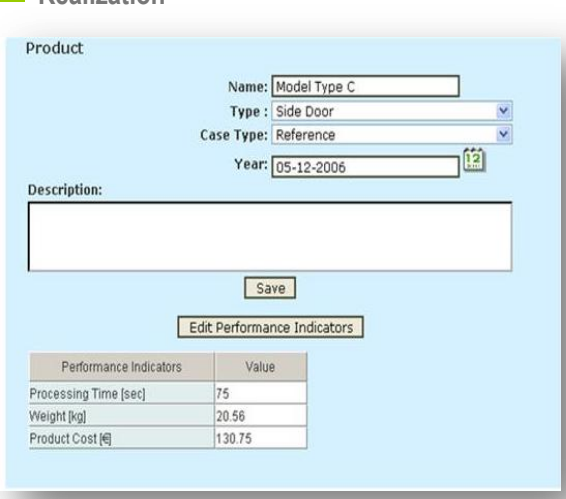
Good cost, time and product weight estimation as early as possible assists controlling the aforementioned parameters , which subsequently implies that the performance and the effectiveness of an enterprise is significantly influenced positively. So far past knowledge from previous projects has not been systematically analyzed for the estimation of Key Performance Indicators such as cost, time and product weight.

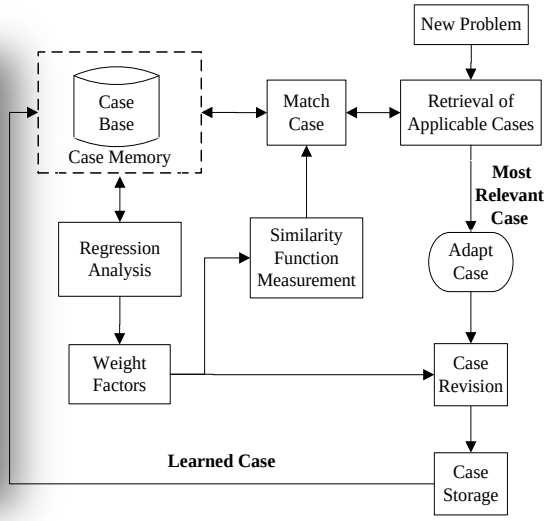
Solution and Concept

Knowledge Based Performance Indicators Estimation tool is based the Case Based Reasoning methodology, enhanced by Regression Analysis techniques. Case representation, similarity measurement and case adaptation - revision are included in the CBR method steps, while regression analysis provides the weighting factors, which are necessary for the calculation of the similarity measurement and the case revision as well. Innovative aspects include:

- Automatic determination of product characteristics weighting factors.
- Minimum amount of input data, in order to be useful as support tool during design phase.
- Utilizing past knowledge from past projects.
- Allows fast preliminary assessment of new possible solutions, in terms of cost and time.

Realization





Area of Application

The present tool supports engineers during product's early design phase.

The Knowledge Based Performance Indicators tool will sustain the industrial progress:

- Decrease investment costs by 20%.
- Shorten time to market by 15%.

Contact Information

Exploitation Leader:	Mr George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	LMS, CRF, CASP		
Website:	www.mycar-project.eu		

MyCar

Result 14: Knowledge Based Decision Support System

Flexible Assembly Processes for the Car of the 3rd Millennium

Knowledge-based assembly plant

Motivation and Needs

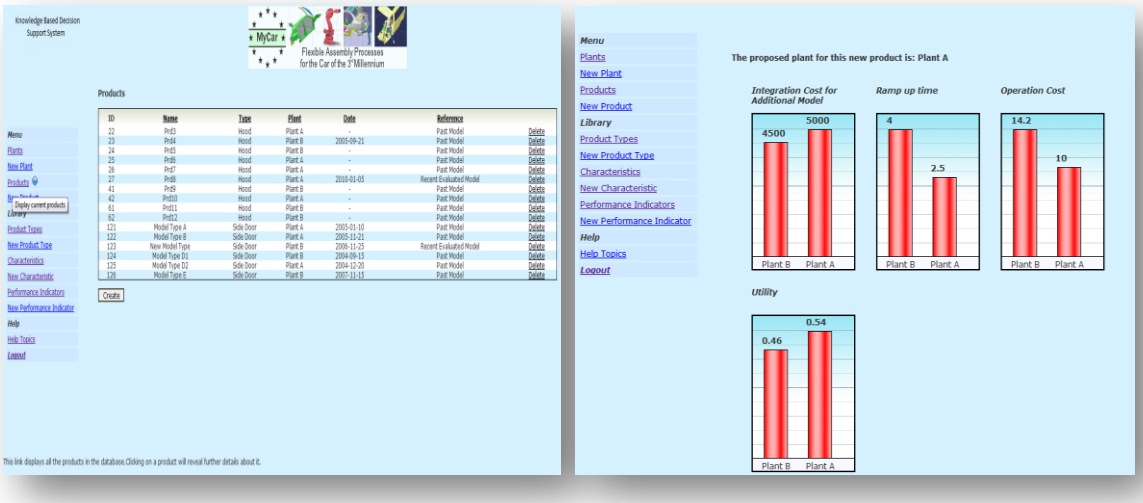
Human experience is utilized, usually in a non-systematic way, in order to allow the project manager to decide where production of a new product (e.g. subassembly, a whole BIW, etc.) should be placed. My Car development would like to propose the best assembly line configuration to be preferred taking into account all the past available production line configurations.

Solution and Concept

Knowledge Based Decision support system is utilizing similarity measurements following the Case Based Reasoning methodology. Past models from different plants are examined with a new model, that is to be produced, in terms of similarity. From each plant is selected one past model, and based on this model, the criteria for the decision making are calculated. In particular, investment cost, operation cost and ramp-up time are utilized in order to assist engineer to decide which plant should be selected for the production of the new product. The innovative aspects of the current development are presented hereafter:

- Utilizing past knowledge from past projects to get fast and efficient information to support decision making.
- Allows fast preliminary assessment of new possible solutions.

Realization



Area of Application

The present tool support engineers during the design phase.

The Knowledge Based Decision Support tool will sustain the industrial progress:

- Decrease investment costs by 20%.
- Shorten time to market by 15%.

Contact Information

Exploitation Leader:	Mr George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	LMS, CRF, CASP		
Website:	www.mycar-project.eu		

MyCar

Result 15: Flexible Fixture for Laser Cutting

Flexible Assembly Processes for the Car of the 3rd Millennium

Self-adaptive assembly plant

Motivation and Needs

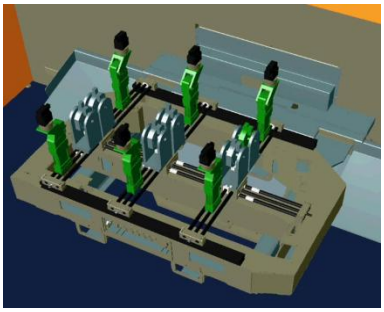
- Despite the 3D laser cutting machines' intrinsic flexibility, the production mix for hot pressed part represents a critical issue in the Body in White manufacturing. The parts, often similar but different, need to be held in a customized automatic fixture during the laser cutting.
- This reflect in the needing of using different fixtures for cutting very similar parts (same family), belonging to different vehicle models. Costs, space and time for production change start to become an issue.

Solution and Concept

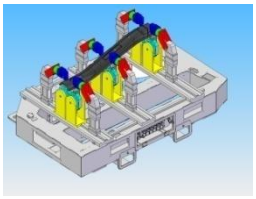
- The solution is the development of a flexible fixture able to hold different but similar parts for the laser cutting process.

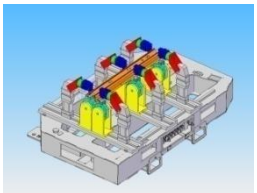
- Using components developed in the MyCar IP project by the partners, it has been possible to make a virtual validation of the possibility of the fixture to adapt itself and manage parts of different vehicle models.

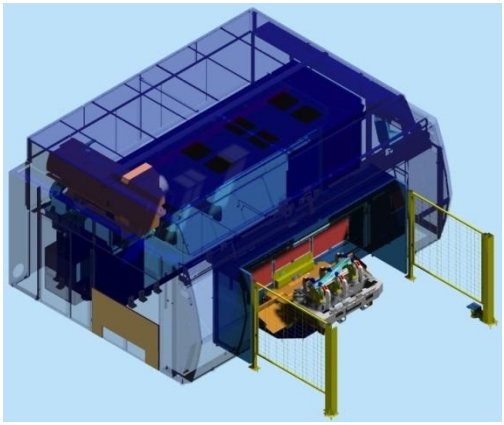
- This concept can be applied to several pressed parts (same families) thus their geometry is very similar.

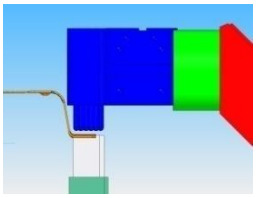


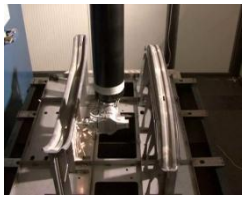
Realization











Area of Application

This result is applied in the Self Adaptive Assembly plant, in combination with ER1 and ER19.
The benefits are:

- Greatly enhanced flexibility of body in white components' manufacturing process, enabling optimization of the entire manufacturing process.
- Reduced space (less fixtures for same production) and costs.
- Reduced time for 3D laser machines re-tooling.

Contact Information

Exploitation Leader:	Chiabra Piero, PRIMA	Contact:	research@primaindustrie.com
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr

Main Partners: TUENKERS, CRF, Comau

Website: www.mycar-project.eu

MyCar

Result 16: Intelligent Algorithm for Rapid Setup of New Welding Parameters

Flexible Assembly Processes for the Car of the 3rd Millennium

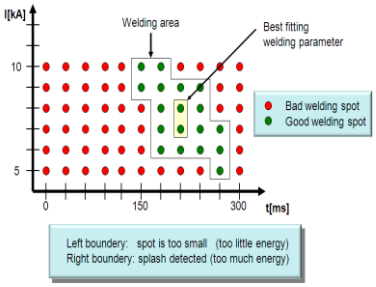
Self-adaptive assembly plant

Motivation and Needs

- Reduction of the ramp-up time of a production line is a urgent need of the car manufacturers.
- Finding proper welding parameters in car body work takes approx. 5% - 10% of the total ramp-up time.
- A reduction of the time needed for finding proper welding parameters leads to a significant reduction of the overall ramp-up time.

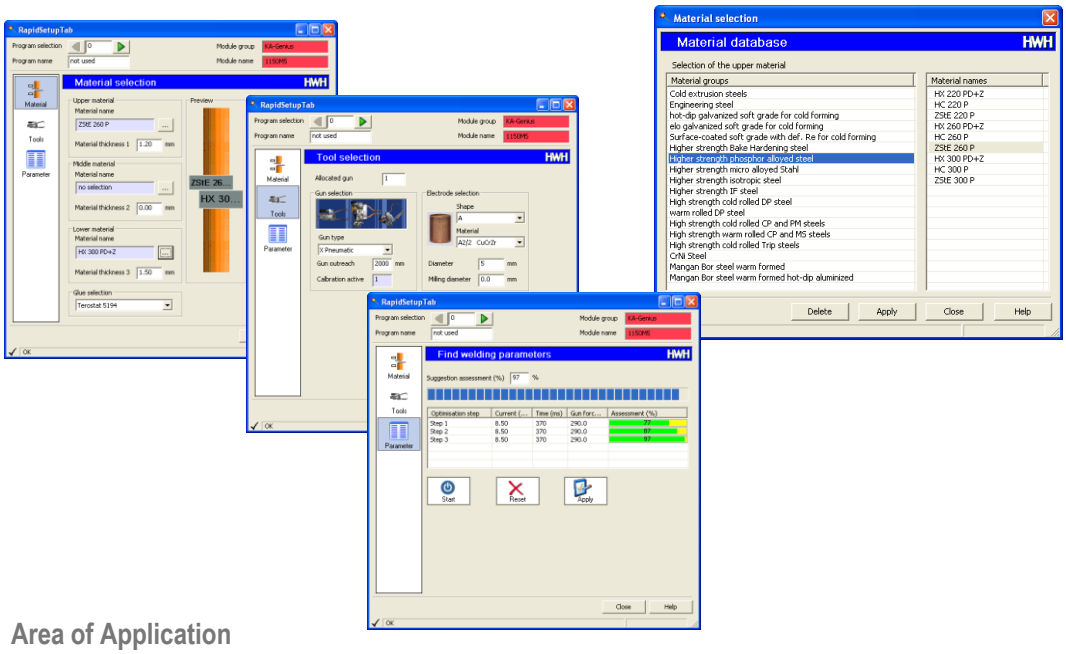
Solution and Concept

- The "**R**apid **S**etup **S**ystem" is a new kind of PC & microcontroller based system for a rapid finding of welding parameters for resistance spot welding processes.
- Whereas nowadays usually 10 - 50 test welds are necessary in order to find proper parameters for a certain welding job, the RSS, drastically reduces the amount of welding tests – maximum 3 tests are needed.
- The RSS works in two operation modes: (i) use of a database for welding parameters without welding tests and (ii) combined usage of database and welding tests for machine-tailored welding parameters.



Realization

•Include a demonstration picture



Area of Application

- The Rapid Setup System is used in body in white in car manufacturing, mainly in the ramp-up phase.
- It can also be used in any other application areas where resistance spot welding technology is used.
- The main advantages of the RSS are:
  - Cost savings due to drastic reduction of efforts in parameter finding.
  - Optimal welding quality due to material and machine tailored welding setup.
  - Potential reduction of energy costs and production cycle time due to optimized welding parameters.

Contact Information

Exploitation Leader:	Ralf Bothfeld, Harms & Wende	Contact:	ralf.bothfeld@harms-wende.de
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	Harms & Wende		
Website:	www.mycar-project.eu		

MyCar

Result 17: Tolerance Monitoring System (TMS) for Resistance Spot Welding Processes

Flexible Assembly Processes for the Car of the 3rd Millennium

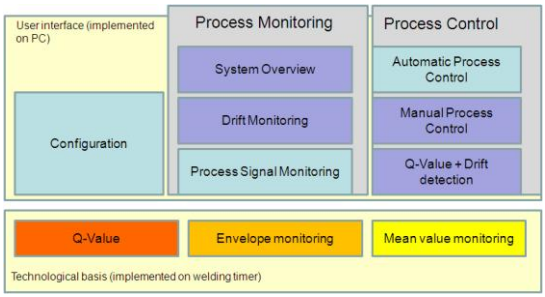
Self-adaptive assembly plant

Motivation and Needs

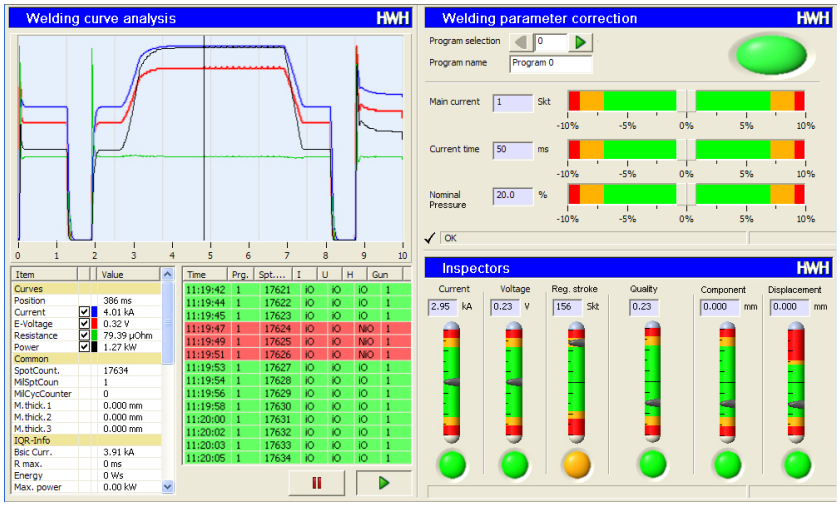
- The assurance and documentation of the production quality becomes more and more important.
- The quality assurance of resistance spot welding processes in body in white is very important due to safety aspects.
- Nowadays, high efforts are needed for ensuring proper quality: Destructive tests are performed or time-intensive calibration of monitoring systems are required.
- There is a urgent need for an easy-to-use automatic quality assurance system.

Solution and Concept

- The **T**olerance **M**onitoring **S**ystem is a new innovative system for the detection of welding process disturbances.
- The TMS is in its algorithm real time front end directly integrated in the welding control. In the background, a PC database is used, as an archive of process data.
- For every welding spot one Quality Value is generated. In addition splatter information is available.
- For automated report generation this quality value can be used to get an estimate on disturbance differentiation.
- A special feature allows for the detection of process drifts over time.



Realization



Area of Application

- The Tolerance Monitoring System is used in body in white in car manufacturing in the operation phase.
- It can also be used in any other application areas where resistance spot welding technology is used.
- The main advantages of the TMS are:
  - Minimal effort is needed to configure the system. There is no need to determine timing tolerances or thresholds. The system is configured automatically.
  - A automatic drift detection allows for early detection of process disturbances.
  - A "Problem Solution Wizard" significantly reduces machine down-time by rapidly finding and correction of the most important process defects.

Contact Information

Exploitation Leader:	Ralf Bothfeld, Harms & Wende	Contact:	ralf.bothfeld@harms-wende.de
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	Harms & Wende		
Website:	www.mycar-project.eu		

MyCar

Result 18: Intelligent Tool for Assembly Line Design and Operation

Flexible Assembly Processes for the Car of the 3rd Millennium

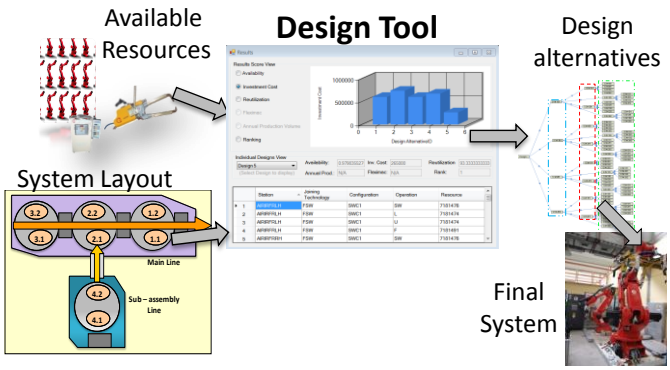
Self-adaptive assembly plant

Motivation and Needs

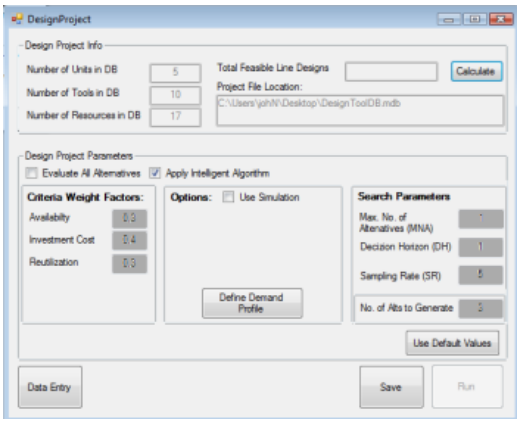
- Complex product structure in combination with the large number of available processing technologies and the large number of resources offered by equipment providers results in a vast number of feasible assembly line designs.
- In the early design stages – few data is available and therefore the results depend on the experts' know how. There is a lack of IT support since existing tools have limited or no capabilities for generating and evaluating new alternative designs.
- Therefore the human designer cannot handle complexity – Support needed in the form of tools.

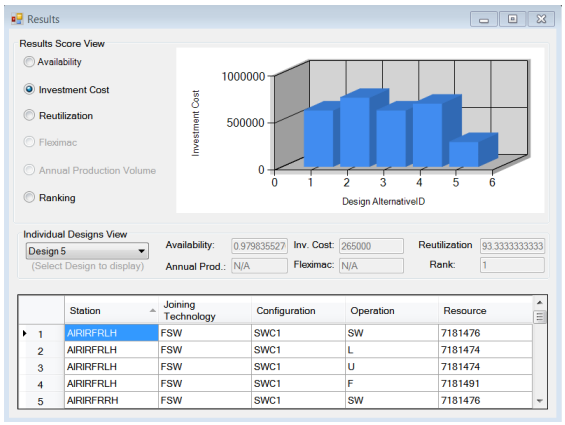
Solution and Concept

- Automatic generation of different assembly line designs.
- Automated simulation to analyze the stochastic behavior of the assembly system.
- Evaluation of system capabilities under different demand scenarios.
- Multiple criteria approach for assembly system design.



Realization





Area of Application

- MyCar applied this exploitable result in the case of a floor assembly line design.
- The expected benefits are:
  - Automatic generation and examination of a large number of design alternatives.
  - Multiple criteria decision making approach, easy incorporation of quantifiable performance metrics.
  - Incorporation of flexibility quantification techniques in the alternatives evaluation process.
  - Equipment selection based on dynamic behavior of each individual resource-exploitation of Discrete Event Simulation benefits.
  - Automated building of the simulation model which can eventually be used in later stages for line balancing/optimization.

Contact Information

Exploitation Leader:	Mr. George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	VOLVO, CRF, LMS, CASP		
Website:	www.mycar-project.eu		

MyCar

Result 19: Flexible/ Reconfigurable End Effectors

Flexible Assembly Processes for the Car of the 3rd Millennium

Self-adaptive assembly plant

Motivation and Needs

Improved flexibility on the production plant it is require from all car manufactures.
With the traditional clamping system each block contour is dedicate to specific and single project.
For each different model of car it is necessary dedicate block contour with no flexibility.

A NEW Production Approach: reconfigurable Bodyshop based on model INDEPENDENT solutions…

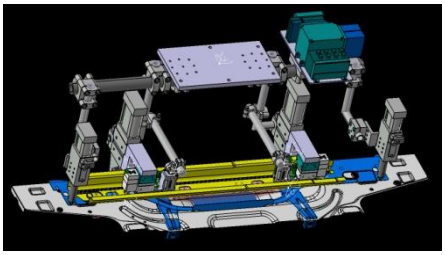
Solution and Concept

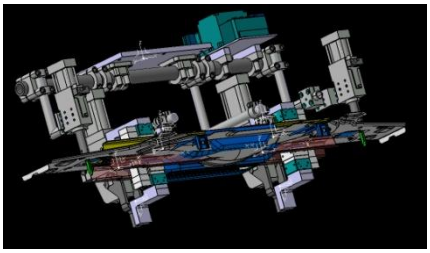
Methodology Description

- Flexible clamping of different model parts.
- Ability to align itself on the real panel from sequence to sequence.
- Increase a number of variants produced in an assembly line.
- Increase utilization at plant level (reutilization for successive production model) with benefit on costs investments and environmental impact.

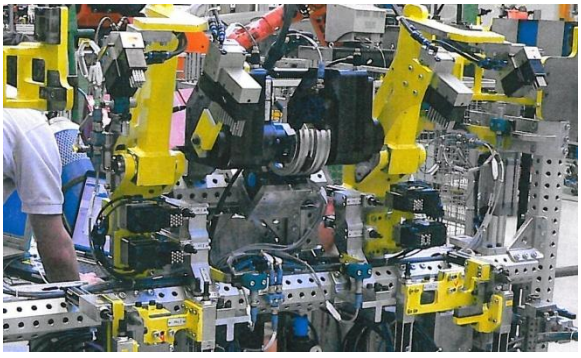
Realization

TUNKERS has developed a permanent handling system for the automotive production lines able to transport different parts.





Flexitool



Area of Application

Dedicated handling robots, using non dedicated flexible and reconfigurable grippers, load the longitudinal rails arriving from the cutting station and the rear cross beams. These flexible grippers are equipped with reconfigurable flexible grasping tools and auto-adaptive clamps that can auto-adapt to different elements' shapes.
Area of application: Handling-Assembly-Stamping automotive and all assembly system of production where highly reconfigurability for several different models or platforms is request.

Contact Information

Exploitation Leader:	Dr.Ing.Andrè Tunkers, TUENKERS	Contact:	at@tuenkers.de
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	COMAU, PRIMA, TUENKERS, CRF		
Website:	www.mycar-project.eu		

MyCar

Result 20: Variant-oriented Planning Methodology, Consulting and Services

Flexible Assembly Processes for the Car of the 3rd Millennium

Virtual assembly plant

Motivation and Needs

In order to be able to produce vehicles in different configurations and different quantities at one production site, flexible production lines are necessary. Anyway, today's planning experts and decision makers often cannot easily identify suboptimal production aspects which are caused by product variety at the early stages of assembly planning. Moreover, methods for assessing intended integration scenarios in a fast, reliable and transparent way are missing.

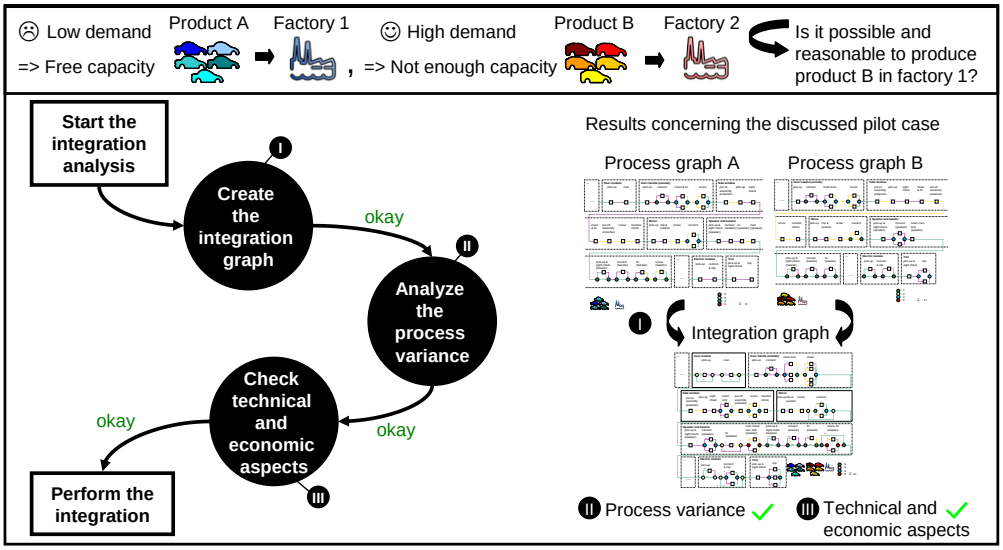
Solution and Concept

The approach that has been developed includes the following two points:

- New variant-oriented planning methods based on graphs visualizing production variance at a glance.
- New assessment methods allowing to make a fast and right decision regarding intended integration scenarios based on
- the superposition of graphs.

As to the points mentioned above, special prototypes which are based on DELMIA software have been developed and pilot cases have been tested for the system validation.

Realization



Area of Application

The developed methods are particularly suitable for the final assembly area. The software prototypes are based on DELMIA Process Engineer, whereas it has also been ensured that the line balancing tool DELMIA Automatic Line Balancing can be used in connection with the new digital graphs. The variant-oriented planning methodology supports car manufacturers in increasing the number of product variants which can be produced in a final assembly line and checking their flexibility in respect of intended integration scenarios. The benefits can be summarized as follows:

- Increased planning transparency (differences between product variants are immediately visible in the graphs; a visual identification of critical areas is possible).
- Improved cooperation within the planning process (especially regarding process planning and line balancing).

Contact Information

Exploitation Leader:	Mr. Michael Datz, CENIT	Contact:	m.datz@cenit.de
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	DAIMLER, CENIT, UdS		
Website:	www.mycar-project.eu		

MyCar

Result 21: Methodology for Production-Oriented Product Validation

Flexible Assembly Processes for the Car of the 3rd Millennium

Virtual assembly plant

Motivation and Needs

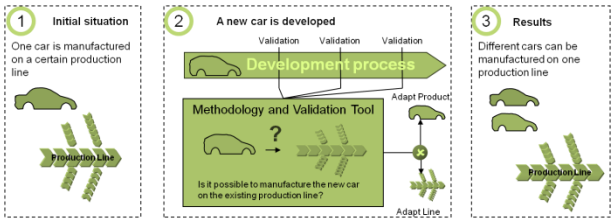
Changing market constraints such as massive increase in the customers' demands, individualization, significant boost in product variety and short time-to-market are added to classical constraints such as time, cost & quality.

Therefore, new concepts for product development and production planning are needed, making it possible to produce on the same line, either several different products simultaneously, or subsequent products.

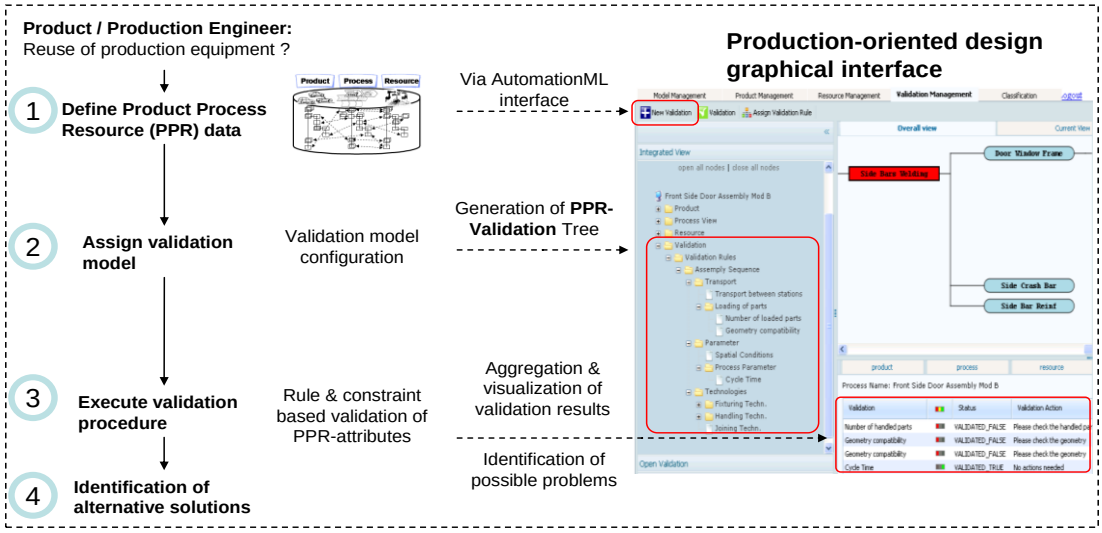
Solution and Concept

The goal is the integration of new developed products on existing production lines while extending the flexibility of the according production facilities supported using a novel methodology supported by a web based tool.

Thus, existing flexible production lines can be validated against new developed products already during the product development process. The basis is formed by a validation model as a set of rules and constraints on the attribute set of the Product, Process, Resource (PPR-) tree.



Realization



Area of Application

The methodology facilitates a consideration of impact of the design decisions on production processes already during the product development process. Thus, an early and systematic application of validation methods for the production process regarding flexible production lines is enabled.

The expected benefits include:

- Avoidance of costly design modifications or improvement iterations.
- Reduction of product design process time.
- Suppression of the gap (or one of the gaps) between product design and production planning.
- Contribution to production cost and time reduction.

Contact Information

Exploitation Leader:	Mr George Papanikolopoulos, CASP	Contact:	gpap@casp.gr
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	DAIMLER, KIT		
Website:	www.mycar-project.eu		

MyCar

Result 22: Environmental Optimization Tool

Flexible Assembly Processes for the Car of the 3rd Millennium

Self-adaptive assembly plant

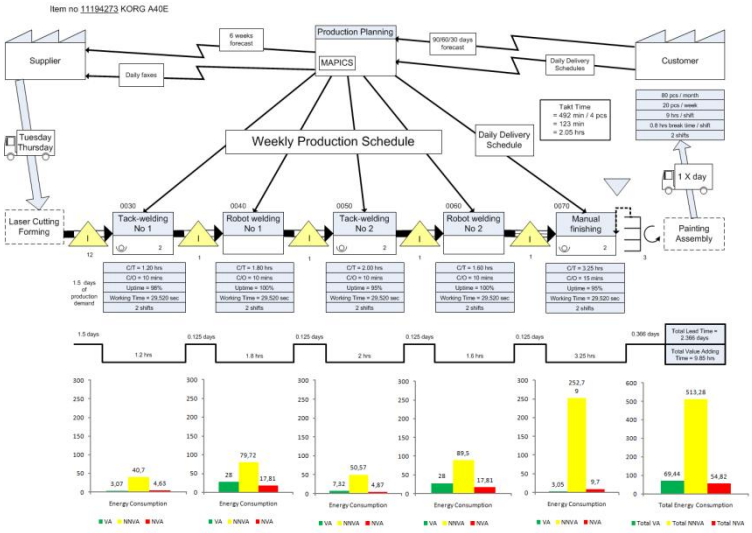
Motivation and Needs

Today, energy consumption and emissions are coming into focus in existing plants as well as when planning new plants. Usually, the drivers for this development are the cost of electricity or fuel. Energy mapping is one of the tools used , but the outcome is dependant on the knowledge and the experience of the performer.

Solution and Concept

The tool is based on Visio and Excel and includes a database with life cycle data on raw materials and energy. The tool maps the use of energy and the emission of e. g. carbon dioxide (CO2) on an assembly line. Hence, it can be used for the identification of value adding use of energy (production), non-value adding but necessary (e.g. start-up time) and non-value adding (e.g. idling time).
Prior to use, data has to be collected on the use of equipment for the actual assembly. Also, data on surrounding equipment not directly involved in the assembly, such as lighting, fans and pumps, has to be collected.

Realization



Area of Application

The developed tool can be used in the following stages of the production lifecycle.

- Planning a new assembly line or rebuilding an existing assembly line (management level).
- Continuous improvements during the use of the assembly line for identification of "hot spots" where energy consumption is high and where some immediate improvements may be possible (operator level) .

The companies using this tool when planning a new or improved assembly line will be able to optimize the energy consumption and use of equipment. This may lead to some necessary initial investments in equipment to reduce consumption of energy, but in the end it will lead to cost savings during the operation of the assembly line.

Contact Information

Exploitation Leader:	Dr. Thomas Lezama, VOLVO	Contact:	thomas.lezama@volvo.com
Project Coordinator:	Mr. Bert Hill, VOLVO	Contact	bert.hill@volvo.com
Project Management:	Dr. Sotiris Makris, LMS	Contact	makris@lms.mech.upatras.gr
Main Partners:	VOLVO, CRF, LMS		
Website:	www.mycar-project.eu		