

Virtual Interconnect

The Role of University Collaboration in the Development of Virtual Interconnect



2nd July 2010
Dr Brian Gilhooley
CEO, Virtual Interconnect Ltd

AGENDA



□ Pre-History.

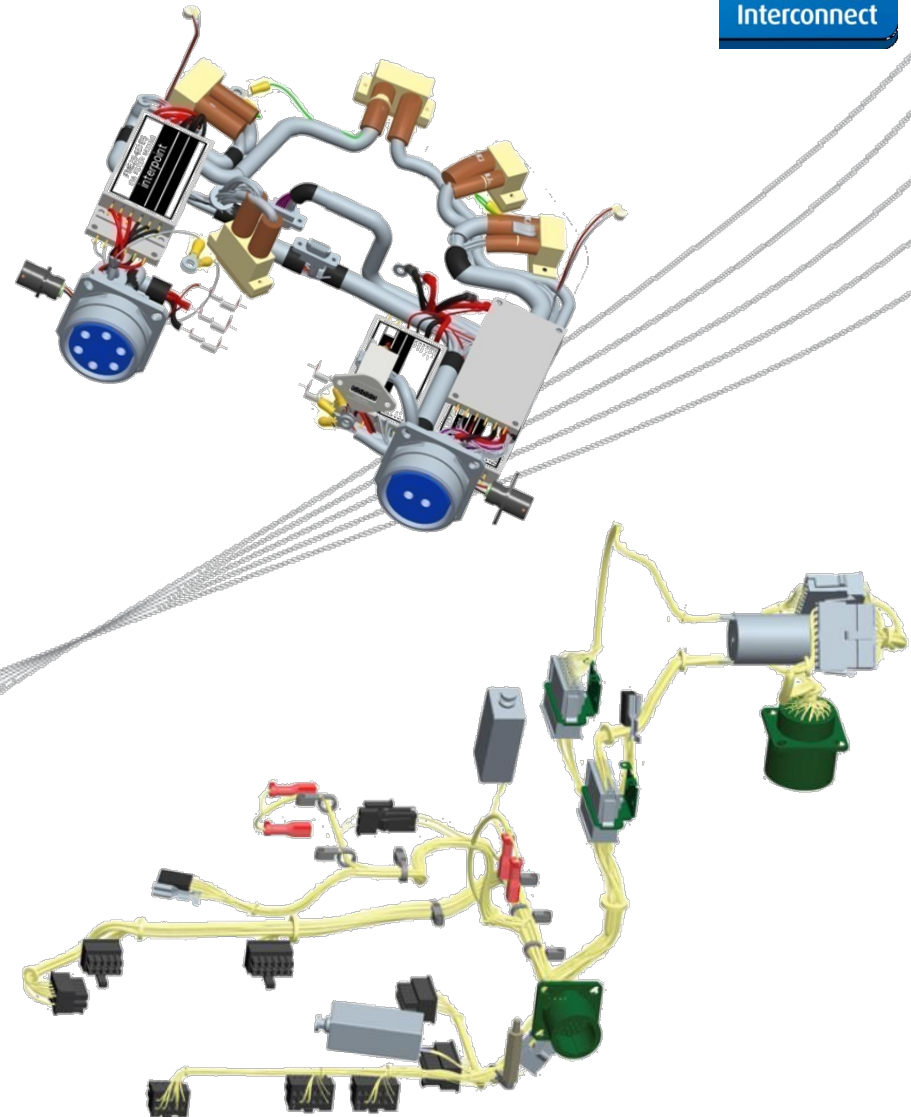
- Clairemont Electronics.
- SMEs & Universities.
- Necessity The Mother of Invention.
- Re-Engineering The Engineers.

□ Roll The Dice!

- Virtual Interconnect is (Still?) Born.
- Early Casualties (The customers!)
- Universities & The Early Days.

□ Collaboration

- Martini Marketing
- Market Research
- SCORE
- CO-STAR
- EngD.
- META



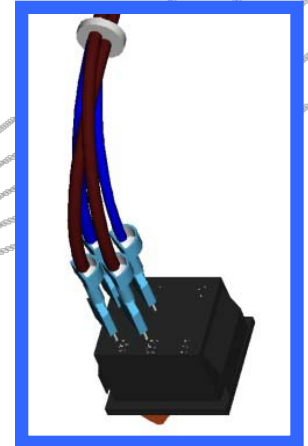
Pre-History – Clairemont Electronics

CLAIREMONT Circa 2000 ELECTRONICS

- ❑ Indigenous subcontractor within Electronics Manufacturing Sector.
 - Low complexity Cable Harness + FA&T
 - Based in Greenock, Scotland, UK.

- ❑ Traditional Business Model.
 - Owner/Manager Model (Lithgows).
 - High Volume, low part count, labour intensive manufacturing.
 - Localised customer base dominated by single large OEM.
 - Low Engineering skill level.
 - Highly Profitable.

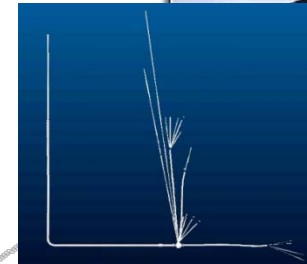
- ❑ The Times They Are a Changin'!
 - Owner bought out by Directors + 3i
 - Threatened by Low Wage Eastern Europe Suppliers.
 - Customer base Erosion. (£3M to 0 in one year!)



Pre-History – Clairemont Electronics



Circa 2000



❑ Bus, Truck & Train Strateg.

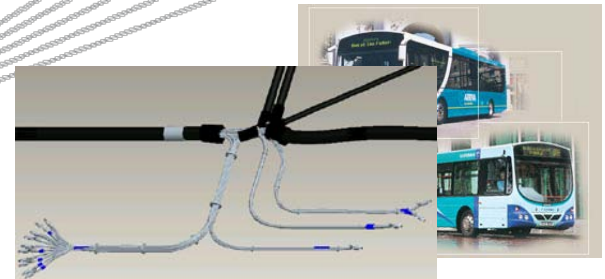
- Products which had to be manufactured in geography.
- Low/Small manufacturing batch runs.
- Complex Products.
- High parts count (2000+ per harness).
- High Rate of Change of product configuration.

❑ Challenges: Systems.

- Islands of technology!
- MRP system: parts ordering, no real scheduling.
- Manual ECN System.

❑ Challenges: Engineering.

- Engineering Skill Base: Not Fit for purpose.
- Estimators + Pre-production Engineers.
- Time to Manufacture.
- No real added value.



Pre-History – Clairemont Electronics



Circa 2000

❑ Re-Engineer The Engineers.

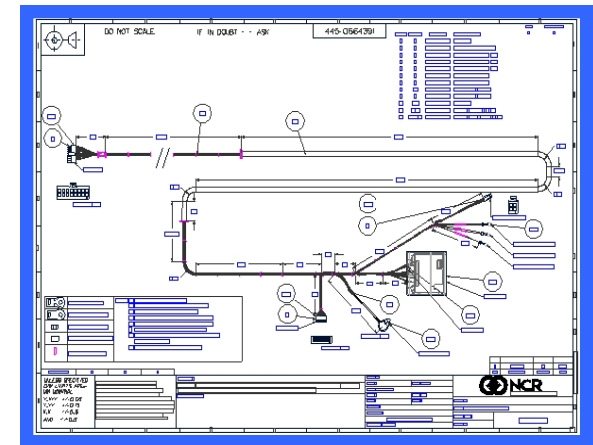
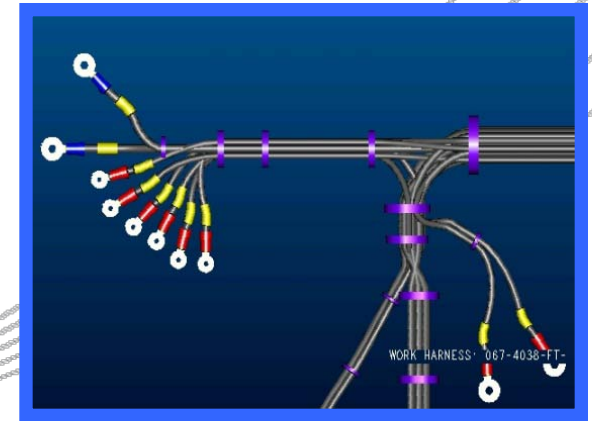
- Required Engineering skill level.
- Talk “Toe to Toe” with customer Engineers.
- Add Value to the product.

❑ Traditional SME View of Universities (+ Professional Engineers).

- Only one beneficiary of the relationship: University.
- High cost for little or no return.
- Not interested in tactical projects, only long term.
- Too removed to drive any benefit.
- Waste of money!

❑ The Hard Sell!

- Recruit Professional Engineers or shut the place.
- Gain Confidence of the customers.
- Improve the manufacturing process in terms of cycle time & data integrity.



“Do you know What You’re Talking About!”



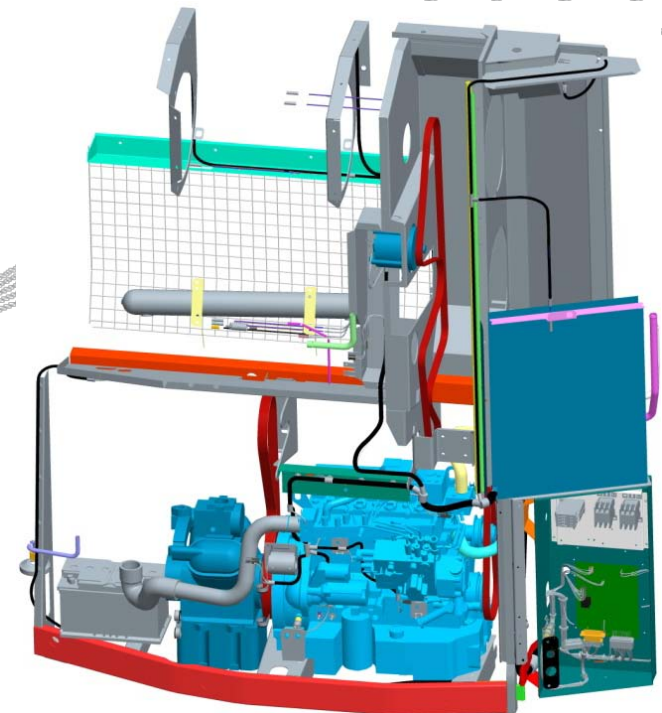
CLAIREMONT
ELECTRONICS

Circa 2000

- ❑ Recruited 4 Professional Engineers
 - Recruitment Fees.
 - Bedding in time inefficiencies.
 - Test System Development

- ❑ After approx 6 months
 - Only one left!
 - Cost approx £20K.

- ❑ Issues:
 - Retention!.
 - Cost.
 - Competing with Motorola etc.
 - Sub contract NOT where you’re career wants to be!



“Last Chance Saloon!/First Contact”



Circa 2000

☐ Looked internal

- Trawled Through personnel Records
- Searched for a Part-Time University Course.
- Looked for Final Year Student projects

☐ First Contact

- Glasgow Caledonian University.
- Expertise in Pro/ENGINEER.
- Paisley University (as it was then)

☐ Sponsored Internal Students:

- Don't ignore what's under your nose!
- Sponsored 4 part students
- Took on 2 summer students (specific areas of the process)

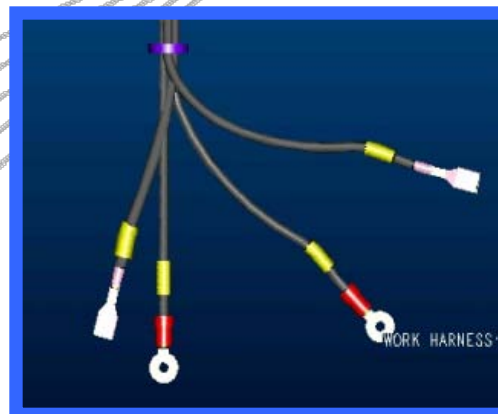
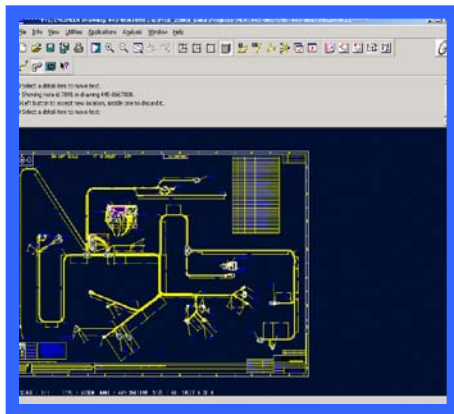
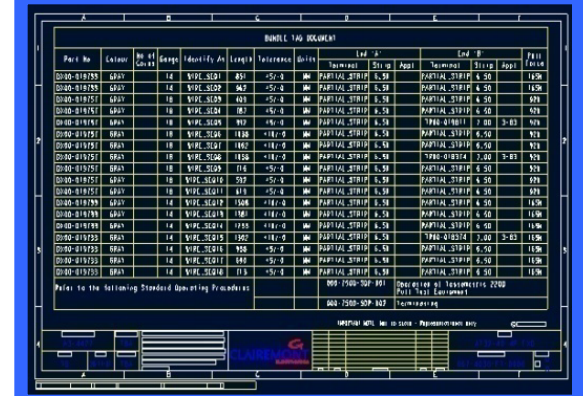


“2D/3D Pre-Production Process”



□ New Pre-Production Process

- Developed as Final Year Project with GCAL.
- 3D Model based.
- Purchased 5 seats of Pro/ENGINEER.
- TRAINED Entire Engineering department,
- *ECN Handling down by 72%*
- *NPI reduced by 50%*

Part No	Section	No of Cords	Group	Identify As	Length	Tolerance	Notes	End A	End B	Part
QD00-019750	QD01	14	WIRE-SC01	831	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		1500
QD00-019750	QD01	14	WIRE-SC02	831	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		1500
QD00-019751	QD01	18	WIRE-SC03	831	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		620
QD00-019751	QD01	18	WIRE-SC04	831	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		620
QD00-019751	QD01	18	WIRE-SC05	837	441.0	MM	PARTIAL STRIP 4.50	TRM 010011 7.00 3-03		620
QD00-019752	QD01	18	WIRE-SC06	1130	441.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		620
QD00-019752	QD01	18	WIRE-SC07	1130	441.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		620
QD00-019753	QD01	18	WIRE-SC08	1130	441.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50	3-03	620
QD00-019753	QD01	18	WIRE-SC09	116	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		620
QD00-019753	QD01	18	WIRE-SC10	527	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		620
QD00-019753	QD01	18	WIRE-SC11	831	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		620
QD00-019750	QD01	14	WIRE-SC12	1108	441.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		1500
QD00-019750	QD01	14	WIRE-SC13	1160	441.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		1500
QD00-019750	QD01	14	WIRE-SC14	1255	441.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		1500
QD00-019753	QD01	14	WIRE-SC15	1202	441.0	MM	PARTIAL STRIP 4.50	TRM 010011 7.00 3-03		1500
QD00-019753	QD01	14	WIRE-SC16	930	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		1500
QD00-019753	QD01	14	WIRE-SC17	840	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		1500
QD00-019753	QD01	14	WIRE-SC18	115	552.0	MM	PARTIAL STRIP 4.50	PARTIAL STRIP 4.50		1500

“Teaching Company Scheme”



“Business re-engineering of the current pre-production process for wire harness assembly to reduce “time to manufacture” through leveraging computerisation and automation.”

❑ Teaching Company Scheme (KTP)

- Good Graduate.
- Guaranteed for 2 years.
- Systems Issues. (MRP I/F)
- ECN System.
- Parts Analysis.

❑ Teaching Company Scheme (KTP)

- Work is in the preparation (1year)
- Financially almost Neutral
- University Involvement, sporadic

KTP Project:

1. Auditing of current processes and determine remedial action to bring them to the required standard.

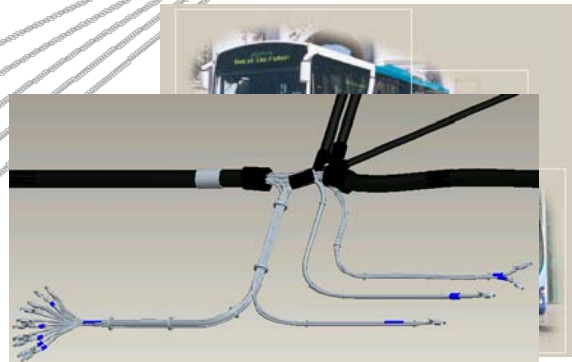
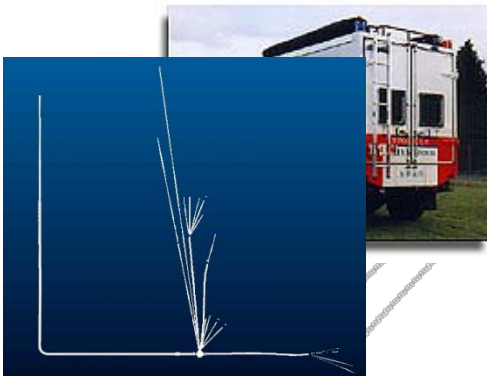
2. Defining, designing and installing a Generic Piece Part Database (GPPD) to

“End of The Road!”

CLAIREMONT ELECTRONICS

❑KTP was going really well, making substantial savings, Bus, Truck & Train Strategy working until.....

- Low Wage Economies bite hard.
- FA&T transferred to Hungary.
- Clairemont goes into Voluntary Administration
- Deep Frustration!

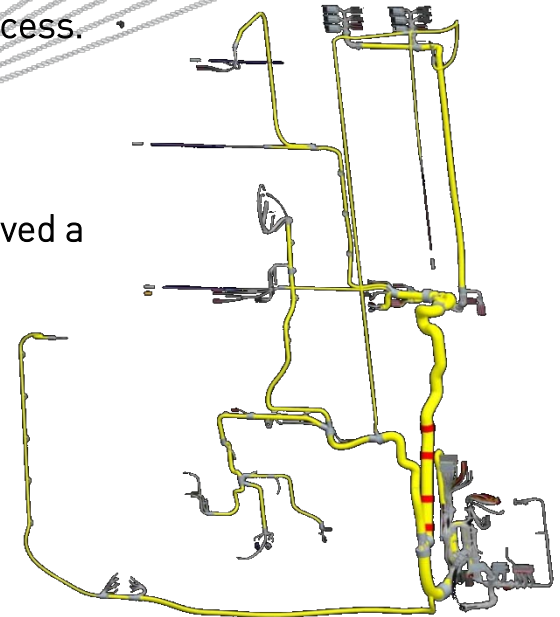


“End of The Road!”



☐ Clairemont and University Collaboration:

- There would no computerised 2D/3D Pre-Production Process.
- No KTP and associated systems improvement.
- No Successful Bus, Truck & Train Strategy.
- The relationship provided Competitive Advantage and moved a labour intensive manufacturing process into a highly computersied, integrated and efficient process.
- And lastly.....
- There would be no Virtual Interconnect!



Roll The Dice!



1st July 2004

☐ Choices!.

- Buy the Harness division of Clairemont.
- Start a new, different type of company.

☐ Virtual Interconnect is Born!

- In a classroom at GCAL, thanks to Phiroze Mehta.
- Business Model: *We don't want to make anything!*
- Develop a fully associative parametric 3D design process.
- Sub-Contract Design Work. (Initially; Service)
- Software Development (Eventually; Product)



☐ Customer's, What Customers?

- Who are you?
- How long have you been in business.?
- Let's see the contracts? (RBS)
- Tapping the staff!

2.3) Vision

The vision is to become the "Best In Class" for interconnect solutions in the areas of Virtual and Physical prototypes. Leveraging Back Office Business systems and individual competence to drive competitive advantage in relevant market sectors.

2.4) Future Prospects

The exit strategy is for a trade sale after 5 years of sustained growth, divisionalising the company en route into Engineering Consultancy and Software Development subsidiaries. A traditional harnessing company such as Leoni or Molex will be targeted for the Engineering Consultancy, while an MCAD house, such as PTC for the design tools.

☐ Roll The Dice!.

- No Customers!
- No Money!



Start-up Business Plan: May 2004 – October 2006
Version 3.2
29th May, 2004



Prepared by

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Commercial in Confidence

1

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Initial Introduction

- Heriot Watt.
- Industrial Partner.
- Professor Jim Ritchie & team.
- Hosted Final Year MechEng.
- One of few Harnessing Research Centres.
- Industrial Contacts.



- 1: Jim Ritchie (Heriot-Watt University)
- 2: Hugh McCann (BAE Systems Avionics)
- 3: Brian Gilhoolley (Virtual Interconnect)
- 4: Sandra Fairweather (Agilent Technologies)
- 5: John Struthers (Agilent Technologies)
- 6: John Simmons (Heriot-Watt University)
- 7: Charles Bevan (JCB)
- 8: Alex Carmichael (BAE Systems Naval Ships)
- 9: Phil Day (Heriot-Watt University)
- 10: Jon Watson (Rolls-Royce)
- 11: Rick Dewar (Heriot-Watt University)
- 12: Rob Cowieson (SCI)
- 13: Graham Robinson (Heriot-Watt University)
- 14: Neil Clark (Heriot-Watt University)

Overview

It is well known that computer-aided design (CAD) systems can bring significant benefits to engineering design through improved quality of output or increased efficiency of the process, and that further improvements to current CAD systems are possible, for example, by providing more intuitive user interfaces that support the natural work flow of the user or through the appropriate use of new technologies. Such technologies include stereoscopic displays and motion tracking systems which together provide the virtual reality experience of being immersed in a 3D computer-generated world. Typically virtual reality systems are used to enhance a user's appreciation of a complex generated model by enabling them to view the model as though they were located within it. Commercial applications include training (e.g. flight simulators) and visualization (e.g. architectural walk-throughs and simulations of spacecraft vehicle mock-ups). However, there has also been significant effort to use such technologies as an alternative to traditional desktop computer systems for other engineering tasks such as manufacturing and assembly planning and computer-aided design.

The Co-Star project extended this previous body of work by investigating many of the technological, human factors, interface design and other issues surrounding the design and implementation of a practical immersive 3D design system for engineering applications, and specifically cable harness design. The project produced an immersive design system using a stereoscopic head-mounted display, gesture interface (pinch gloves), and body motion tracking that enabled users to produce outline harness designs whilst also providing the interface for a larger more comprehensive design platform.

The system was evaluated by ten participants who each used it to complete three cable harness design tasks. During each design task the system produced a time-stamped recording of the user's interactions with it. These files were subsequently analysed to profile the distribution of user activity (i.e. Design, Navigation, System Operation, Information and Process Integration related activities). The profile contributed for the first task from the average performance of all participants shows that task completion accounted for 41%, Design 27% and System Operation 23% of user activity during the design task.

Structured questionnaire and interview sessions took place immediately after each design session, with the participants scoring their opinion of features of the system and the technology from 'very negative' to 'very positive' on a balanced 5-point scale. These scores were used to identify the strengths and weaknesses/features of the system from a user perspective. Importantly too, the defining features of an immersive design system, immersion and direct 3D interaction were identified as the key strengths of the Co-Star system, whilst feature weaknesses were a number of specific interface features that can easily be changed.

Overall the participants responded positively to the immersive design experience, and the results provide a compelling insight into the distribution of user effort during an engineering design task, which combined with the user feature ratings provides an important operational benchmark that identifies the essential usability and performance criteria for the development of future stereoscopic design systems.

Cable Harness Design

A cable harness is an assembly of wires, connectors and fasteners that provide the electrical interconnectivity between the different modules of electro-mechanical products. Cable harnesses can follow complex 3D routes within a product and developing a design that fulfils all the electrical, mechanical and assembly requirements can present major challenges to the engineers involved. The reason for using a stereoscopic design system is that immersing the engineer in the 3D product model and enabling direct interaction with it increases the engineer's spatial understanding of the product and allows a more intuitive interaction with the design leading to better more cost-effective harness designs being produced in a shorter time.

Results

Questionnaire Results

System Feature	Rank Score*
Strengths:	
Object drag & drop	0.0
Being immersed in the design data	0.4
The pinch gloves (gesture interface)	0.3
3D object interaction	0.3
Global model navigation (flying)	0.3
Weaknesses:	
Using cables to connector tool	-0.4
Graphical feedback when selecting objects	-0.4
System mode feedback	-0.4
Finding inverted cable points	-0.6
Object selection filters	-0.6

*No average feature rank score 0

User immersion and direct 3D object interaction which are defining features of an immersive design system model were identified as the main strengths of the Co-Star system. The weakest features were a number of specific software interface issues that can easily be designed out.

Operational Performance

Process Design

Design 41%
System Operation 23%
Information 27%

Despite the generation of design data being the core purpose of the task only 27% of user activity directly involved with this. A similar amount was spent on operating the system and other more used to move around the model. Developing new interface techniques that improve the efficiency or decrease the need for long flight time System Operation are essential so that less time is spent on these activities allowing more time for productive design work.

Personnel: Day P N., Holt P O B., Ritchie J M., Robinson G., Simmons J E L.
Collaborators include: Agilent Technologies, BAE Systems, Claremont Electronics, NCR, OCF

Using Co-Star

Drag & Drop Edit of Cable Routes
Create Cable in Model
Mixing Connectors
Ring Menu System

IMCRC THE SCOTTISH MANUFACTURING INSTITUTE An EPSRC Innovative Manufacturing Research Centre **EPSRC**

KTP Continues



❑KTP Continues, but different.

- Phiroze Mehta & Gerry Black.
- Refocus on software development; Web Shop.
- Commercial software development.
- Web shop to enable global selling of product.

❑Paisley University; Here's the Deal!

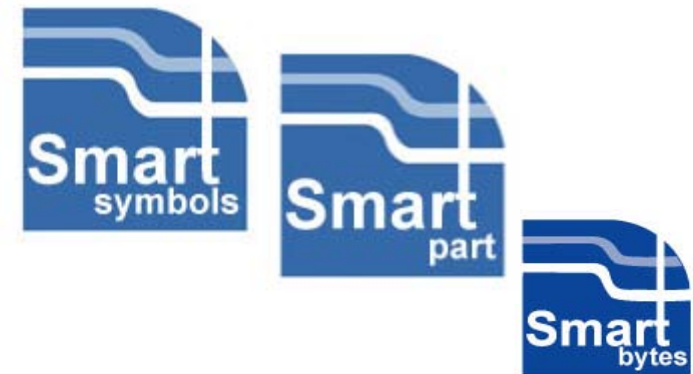
- UNPAID part-time Students.
- We train you, then we buy parts from you.
- Populate our 3D libraries

❑Punch Line.

- Really good web shop!
- Loads of 3D Models
- Didn't Sell a Bean!

❑Positives.

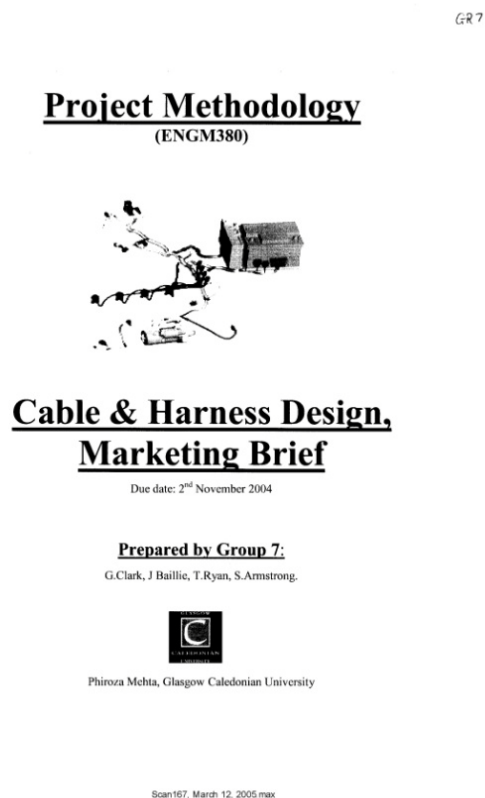
- Led to 2 full-time members of staff!
- Raised the profile of the Company
- Taught us about the need for real marketing.
- Kurian landed a £60K job in London!



Market Research

□ MCAD Market.

- GCAL Engineering Department, Phiroze Mehta
- 8 Groups of Part time Students.
- 8 Market Reports.



□ Strathclyde Graduate Business School

- Oil & Gas Market, Entry Strategy for Virtual Interconnect.
- Mature MBA students
- 2 dissertations in subsequent years.
- 2 Detailed Marketing Reports.

DEVELOPING A SUGGESTED STRATEGY FOR
VIRTUAL INTERCONNECT TO PENETRATE INTO
THE UK OIL AND GAS INDUSTRY

Submitted in partial fulfillment of the requirement of the
degree of Master of Business Administration of the
University of Strathclyde

THE UNIVERSITY OF STRATHCLYDE
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Professor Valerie Belton

28th January 2005

Marketing Brief

BACKGROUND: The Mechanical Computer Aided Design (MCAD) market is currently undergoing a paradigm shift from 2D to 3D CAD tools. This is being led by the Original Equipment Manufacturers (OEMs) in an effort to gain competitive advantage by reducing time to market and overall product development costs. It is anticipated that the OEMs will pull through their 1st tier suppliers, as was the case with 2D MCAD tools e.g. AutoCAD. Market research is required to establish where in the migration process the major OEMs are (3D vs. 2D) and which of the major MCAD tools are being adopted, Unigraphics, Mentor Graphics, AutoCAD, SolidDesigner, Pro/ENGINEER, CATIA, etc and where on the migration path are the 1st tier suppliers. It would also be of interest to establish if there is a market correlation with the CAD tools available.

Two project options are presented below. The first addresses the adoption of 3D MCAD tools within specific market sectors, the second the adoption and use of specific cable and harness EDA software generally. VI operates within the cable and harness design market as both providers of project and implementation solutions. Therefore it would be of interest to establish if the market place would outsource some of their cable and harness design work and if there was a requirement for help in implementing a Pro/ENGINEER harnessing solution. It would also be of interest to establish which cable and harness software has the best price/performance characteristic and the size of the associated userbase.

1) Market Sector Project.

Choose a market sector from the following list and implement a market research project in accordance with the objectives outlined below.

- a) Gas & Oil
- b) Military
- c) Medical
- d) Rail
- e) Aerospace.

1.1) OBJECTIVES:

- a) To establish which OEMs are using 3D MCAD tools and to what extent.
- b) To establish which 1st Tier suppliers are using 3D MCAD tools
- c) Which of the major MCAD tools are being used and the market share of each.
- d) Which OEMs are using 3D MCAD tools and also have a Cable & Harness requirement.
- e) Which of the OEMs use Pro/ENGINEER and have a cable & harness requirements.
- f) Which of the Pro/ENGINEER users would outsource cable & harness work.
- g) Which of the Pro/ENGINEER users would retain implementation consultants.

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☐ Staff Retention.

- Not everyone is motivated solely by money.
- Stepping stone to a more lucrative career.

☐ External Recognition.

- Work that is going to be done anyway.

☐ Personal Development

- Take Responsibility for own work

☐ Views

- Academic & Work Commitment.
- More support for Part-Time route.
- Open it up to a more general audience.



CABLE HARNESS DESIGN - LOGICAL PROCESS OR A BLACK ART?

Introduction.

Cable Harness Design is a complex process with many variables and constraints which need to be taken into account by the Design Engineer at source. These constraints must be carefully balanced to generate a solution which does not compromise safety over the entire product lifecycle. The cable harness design process is traditionally characterised with a lengthy iterative cycle with associated risks, delayed product launch, increased cost to market and expensive infrastructure re-tooling. Improving this is critically important in today's world where the emphasis in new product design is firmly on providing the end user with additional features whilst successfully implementing technology advancements in mechanical and electrical disciplines to ensure superior products. The 'fit and finish' mentality inherent in many industries with cable harness design must be re-examined and given due credence as an essential system requiring regular inspection and maintenance throughout the ever expanding lifecycle.

What is a cable harness?

A cable has various definitions, which include:

- A group of wires or ribbons used to connect electrical systems or sub systems.
- An arrangement of wires and cables, usually with many breakouts which have been fed or pulled into a rubber or plastic sheath, used to interconnect an electrical circuit.

The image on the left illustrates a typical electrical control box from a refrigeration unit used to regulate the temperature of a truck carrying fresh produce.

More often than not, we take complex wiring systems for granted simply because we cannot see them. Even today with system complexity increasing, the significance it deserves.

Physical cable harness plays a critical part which is often not given the

Harness design engineers strive to produce solutions which take into account the following constraints and variables.

Constraints	Variables
Weight	Terminal Impedance
Temperature	Wire Length
Routing	Wire Gauge
Voltage	Insulator Material
Vibrations	Conductor Material
EMC	EMC
	Age
	System Protection
	System Segregation
	Location
	Initial Installation
	Routine Maintenance
	Inspection Methodology

Why is cable harness design important?

Cable harnesses connect major sub systems together. We rely on these interconnect solutions to work every day, whether they are in the white goods in our kitchens, in our cars or in the airplanes that take us on holiday. More often than not, however, these interconnect solutions are inadequately designed, causing failure and potential risk of injury or death.

Recent examples across industry sectors include:

AIRBUS A380

The well publicised wiring issue with 330 miles of wiring, 100,000 wires and 40,300 connectors resulting in 5.5 tons overweight.

Design decision taken: Change from copper conductors to aluminium conductors.

Result: Increased bundle diameter resulting in harness not able to physically fit through the bulkheads.

MAYTAG/WHIRLPOOL/GE Dishwashers

In 2007 alone there has been almost 5 million dishwashers recalled as a potential fire risk. In the Maytag case it was caused by leaking dishwasher fluid causing a wiring fault. Similarly with Whirlpool dishwashers, another fire risk with the electrical wash motor overheating.

Year	Brand	Number of Recalls
1988	Whirlpool	75,000
1995	Maytag	553,000
1996	Whirlpool/Kenmore	500,000
1999	GE Hotpoint	3.1 million
2005	GE	74,300
2005	Whirlpool, Kenmore	162,000
2007	Maytag, Jenn-Air	2.3 million
2007	GE	2.5 million

FORD

In August 2007 the Ford Motor Company announced a recall of 3.6 million cars, trucks and SUV's for the installation of a fused wiring harness into the seven control circuit.

The recall follows a previous, similar recall of 8 million cars, trucks and SUV's in 2005.

What can be done to make to professional harness engineers more competitive?

Designing a cable harness is a complex task. Often conflicting requirements come together making the final solution a compromise. We must ask, can harness design effectively taught or disseminated and practice solutions still play a significant role? Is the physical prototype harness the best medium for compliance testing or can the virtual harness prototype play a more important role?

Can avoiding seemingly minor mistakes in the design process reduce the tremendous potential for significant failure?

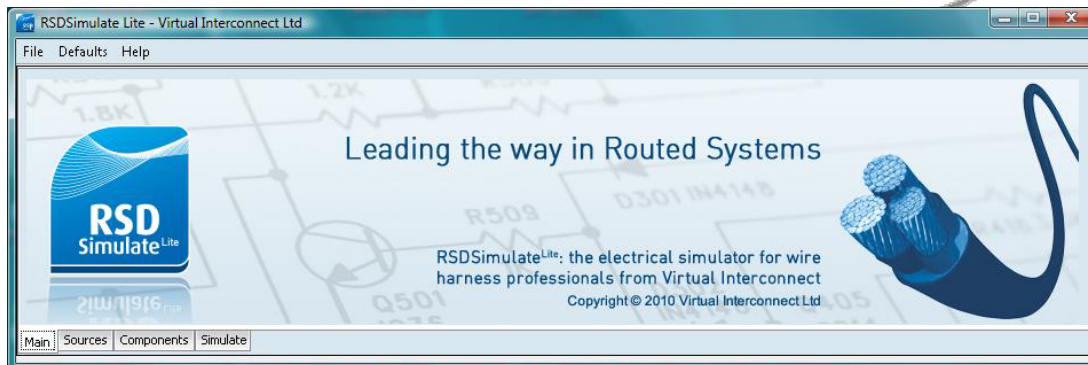
The underlying aim of this project is to challenge and remove the perceived 'Black Art' from the Cable Harness Design Process by providing easy to use tools to enable the engineer to make decisions based on compliance and regulatory requirements.


This project will identify areas of shortfall in currently available harness design tools and by applying decision tree methodology and a logical approach, quantify & qualify optimum solutions and provide compliant systems for the engineer to make the informed decision. This methodology should minimise the chance of making a minor mistake in the design process and further reduce the tremendous potential for significant failure in later stages of the product lifecycle.

The methodology envisaged includes:

- ☐ Through investigation of current industry standards and trends.
- ☐ Discussion and analysis of selected OEM's on their current wire harness design processes.
- ☐ Discussion and analysis of the selected OEM's 1st and 2nd tier suppliers design and manufacturing processes.
- ☐ Analysis of the root cause of failure in the OEM's products.
- ☐ Design of a harness process optimisation algorithm.
- ☐ Production of a decision based software toolkit for the engineer to use everyday to help produce optimum lifecycle solutions.

- ❑ Helps Drive Competitive Advantage.
 - Skills Acquisition.
 - Helps develop Distinctive Competencies.
 - Professional Software development.
 - Latest academic thinking.
 - ANT Theory for process analysis.





Diagnostic Simulation

Overview

Electrical fault finding on complex wiring harnesses can be a major challenge. The objective of this project is to investigate the potential for a wire harness diagnostic tool. Given a number of empirical measurements of either voltage or current and the relevant electrical schematic, the algorithm should be able to predict the fault mode of the harness or guide the operator through an iterative series of measurements to identify the fault.

Complex wire harnesses can contain tens of thousands of components and hundreds of kilometres of wire. Manual fault-checking is time-consuming, costly and prone to errors. If a diagnostic algorithm capable of handling such a system can be found, it will improve both efficiency and accuracy.

The design of wire harnesses depends critically on both electrical and mechanical parameters. The physical routing of wires and cables introduces variables which a purely electrical simulation will miss. Thermal and inductive effects cannot be accurately modelled without reference to the geometry of the harness. Furthermore, geometry constrains potential faults due to changes in connectivity, such as short circuits. Thus both simulation and diagnosis depend strongly on more than just electrical properties.

An important challenge is to maintain sufficient generality to allow further expansion. Redesign or enhancement of the simulation module should not require radical alterations to the diagnostic algorithm. Retaining a good level of flexibility will be important to future development and research.

Diagnosis

Electrical simulation can be thought of as a mapping from one high-dimensional space, representing the free parameters describing the circuit (resistances, capacitances, connectivity etc.), to another, representing observations of the circuit such as voltages and currents.

Diagnosis, then, is the process of inverting this mapping, from a set of observations, we wish to recover a set of values describing the actual state of the circuit.

This problem is made considerably more challenging by the absence of complete data. In general, the observations available will be relatively sparse. Wire harnesses containing tens of thousands of components are common, and measuring all voltages and currents is effectively impossible.


With only sparse data to work with, diagnosis becomes a search through the space of possible circuits, subject to constraints derived from the available observations. This formalism is not specific to electrical circuits, but can model a wide range of diagnostic problems.

Simulation

Virtual Interconnect Ltd. has developed a SPICE-based electrical simulator which will form the implementation basis of this project. **RSDSimulate** will function both as part of the diagnostic process and as an experimental test rig for further study and evaluation.

Integrated with both a schematics package (Routed Systems Designer) and a 3D modeller (ProENGINEER), RSDSimulate allows realistic simulation of wire harnesses, accounting for mechanical properties.

RSDSimulate provides a wide range of analysis options for comprehensive testing, and a design rule checker module to ensure consistency.




RSDSimulate also allows simulation of multiple circuits simultaneously, allowing multiple potential solutions to be tested in parallel.


Electrical Faults

The challenges posed by electrical faults and their diagnosis cannot be underestimated. The Airbus A380 contains approximately 530 kilometres of cabling. Design errors in the wiring contributed greatly to delays which ultimately cost **US\$6 billion** and **ten thousand jobs**.

While the economic cost of faults in the design and manufacturing stages are immense, faults during operation are even more serious. Wiring faults can cause serious problems in-flight, and in some cases have led to crashes.

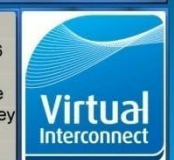
Comprehensive simulation during the design process, combined with accurate detection, localization and diagnosis of faults in the finished product is of vital importance to the efficient production of robust solutions.





All of these features contribute significantly to the diagnostic process.

Martin Mehta
Start date: 08/06
Supervised by:
Mr James Richie
Dr Brian Gilhooley
Prof. J. Corney



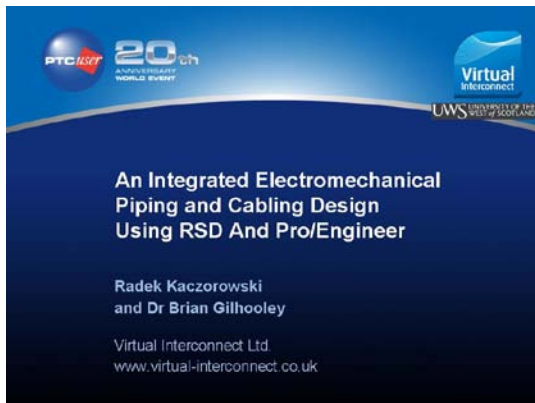
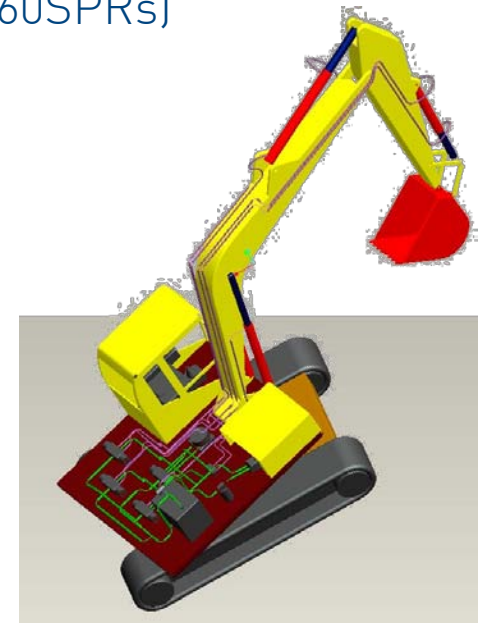
Creative 3D Digital Technologies EngD
Poster Session 2007

“To deliver a fully documented, associative and parametric routed systems piping and hydraulics design process”

- Collaborative Research with UWS.
- 18 month program, now complete.
- Includes RSD & Pro/PIPING Functionality Review. (60SPRs)
- Process Mapping of Industrial Piping Processes.
- Future software products.

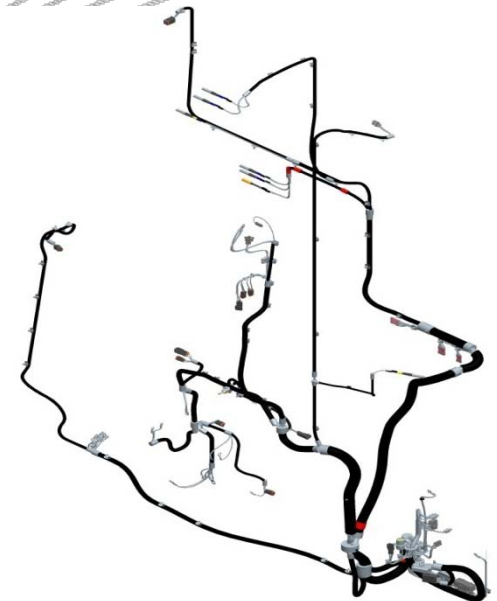
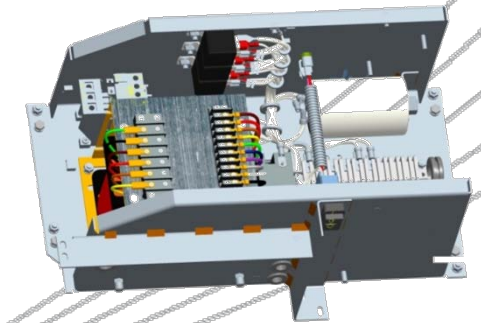
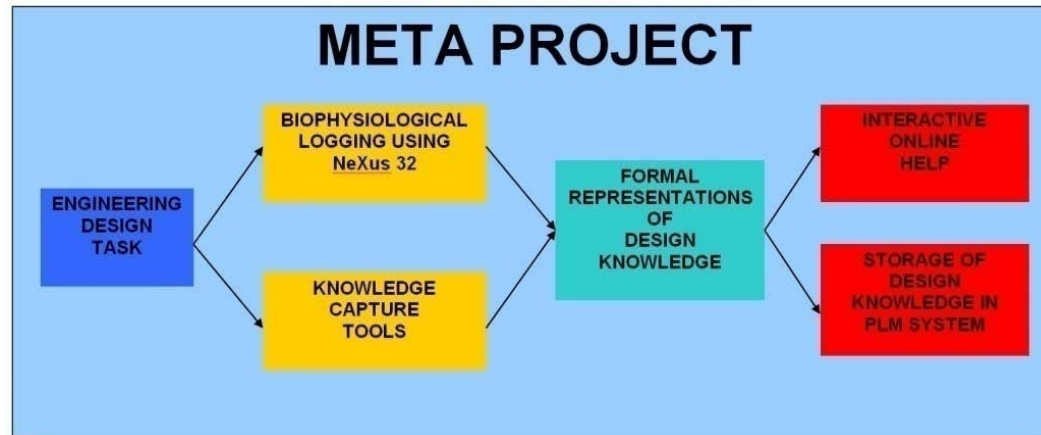
THALES

bvt
surface fleet



Industrial Partner.

- Supplied 3D Geometry.
- Supplied Engineers for experiments /Trials.
- Matchmaker with PTC Inc.
- Future Trials in Sept. '10



SME's, University Collaboration and Competitive Advantage.



❑ No Collaboration, No Virtual Interconnect.

- Provided a vehicle to develop competencies, 3D Modeling.
- Negated Entry Barriers.

❑ Provided Access to good minds, when we couldn't afford to recruit!

- Mature MBA students.

❑ Provided access to new competencies, we couldn't access.

- Hydraulics.
- Actor Network Theory (ANT)

❑ Provided a method for staff retention.

- Academic Qualifications.

❑ Networking Opportunities.

- Co-STAR & META Industrial Partners.

❑ Saved us From Venture Capitalists.

- Helped us develop competencies at our own rate.



University Collaboration and Virtual Interconnect.



❑ Enabled Repositioning of Company.

- From a Service to a Software Product Company..

❑ Enabled Diversification.

- Piping/hydraulics
- Oil & Gas Sector

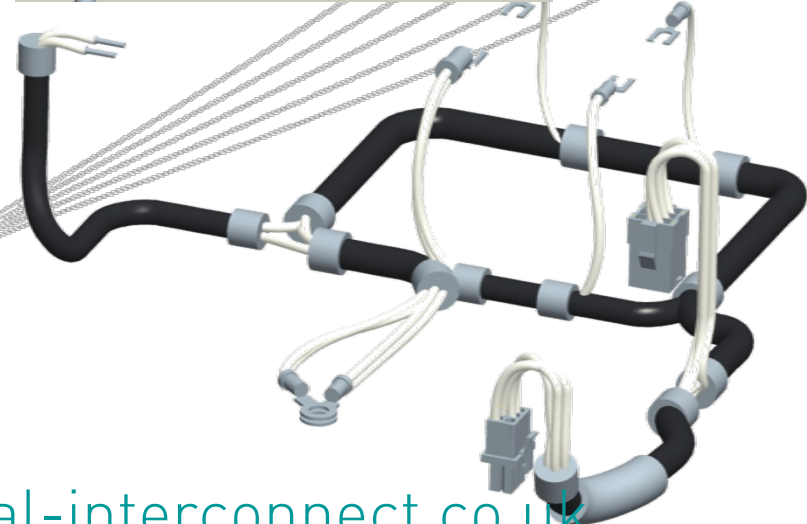
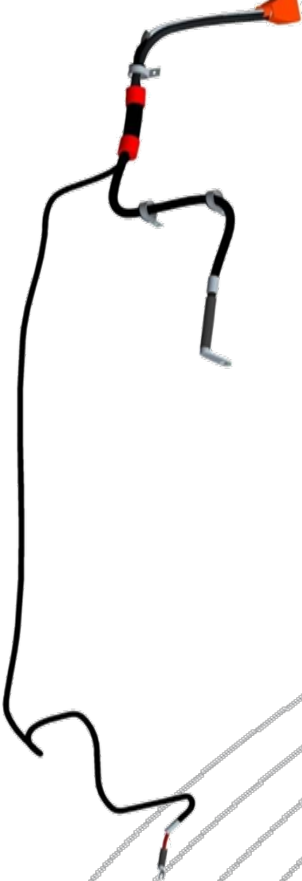
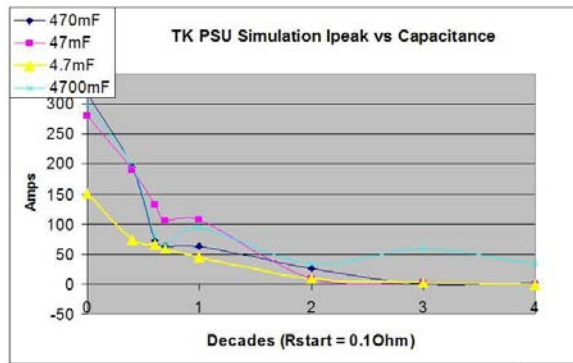


❑ The Future with Heriot Watt.

- Relationship going back 10 years.
- Valued.
- Meta Project.
- New Project: Hydraulic Simulator.
- New Project: Estimation of Surface temperature of wires & cable bundles.



Questions?



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