I3E

S o u t h   E a s t   E u r o p e   T C P

Best Practice Report

UltraSOC

Document type   :   Best Practice Report

Document version   :   Draft

Document Preparation Date   :   January 12th, 2011

Classification   :   Internal

Contact   :   Christos Anagnostopoulos

Project co-ordination   :   ISI – Industrial Systems Institute

Deliverable Responsible   :   ISI – Industrial Systems Institute

Rev.	Content	Resp. Partner	Date
0.1	Creation of document	ISI 17.1.2011	

Everybody please state revision index and short description of what has been done + partners involved and date.

Final approval	Name	Partner	
Reviewer			

1. Best Practice Title
UltraSOC

2. Location of Best Practice
Country, region, town

Cambridge

United Kingdom

3. Best Practice Executive Summary
Describe briefly (max 10 lines) the GP context (partnership, funding, objectives, approach followed, results)

UltraSoc Technologies (UST) was founded in 2006 as a spin-out from the University of Kent and became a joint spin-out with the University of Essex to exploit the research carried out by Professor Klaus McDonald-Maier with Dr Andrew Hopkins and their team. The company aims to develop and market UltraDebug ™, a highly flexible, multi-processor, System-on-Chip (SOC) debug support platform. UltraDebug ™ will provide superior, application-level, debugging facilities, enabling the embedded systems industry to create more advanced and reliable products in markets such as automotive and consumer devices.

4. Best Practice Classification

Best Practice Theme
☑ *Research Transformed to Innovative Product*
☐ *Research Transformed to Innovative Service*
☐ *Research Transformed to Innovative Methodology*
☐ *Research Transformed to Innovative Production Process*
☐ *Financial Mechanism for Transformation of Research to Innovation*
☐ *Support Mechanism for Transformation of Research to Innovation*
☐ *Other (describe)*

Best Practice Research / Application Areas
☐ *Industrial / Manufacturing Systems*
    ☑ *Industrial Informatics and Communications*
    ☐ *Intelligent Devices*
    ☐ *Distributed Control Systems*
    ☐ *Flexible Manufacturing Systems*
☐ *Embedded Systems*
    ☑ *Industrial Embedded Systems*
    ☐ *Nomadic Environments*
    ☐ *Private Spaces*
    ☐ *Public Infrastructures*

5. Description of Best Practice
5.1 Best Practice Context
Overall background of the Best Practice. Location, socio-economic, technical & policy background of the BP (max 10 lines)

UST (Cambridge, UK) is an independent provider of System-on-Chip (SoC) infrastructures that enable rapid development of embedded systems based on advance SoC devices. The development of the technology platform builds upon EPSRC (Engineering and Physical Sciences Research Council) funded research work undertaken by Dr McDonald-Maier and his group at the University of Kent as well as funding from the South East Proof of Concept Fund.

UltraDebug[TM] is being designed to offer advanced source-level debugging with superior trace and trigger facilities. It will enable developers to capture their system's detailed operation and interactions at the most critical points in time and for extended profiling durations. Profiling and performance measurements are also aided by UltraOptimize[TM], which supplements the developer's preferred tools. It provides easily accessible visualisations of task execution times and their level of variation when executed in a prototype or final product. UltraOptimize [TM] can be used with UltraDebug [TM] or as a standalone tool.

5.1.1 Policy Elements

What are the policy initiatives that have influenced the contextual environment of BP: innovation promotion policies, research funding policies, certification ect as well as relevant tools (max 10 lines)

The core research technology of the project was heavily funded (circa £2million) by EPSRC, before the company was founded back in 2006. EPSRC's is a British research council that provides government funding for grants to undertake research and postgraduate degrees in engineering and physical stages.

UST promoted its research by participating in competitions such as the prestigious Research Councils UK (RCUK) Business Plan Competition 2005/06. The aforementioned competition provides researchers who have ideas with commercial potential the skills, knowledge and support needed to develop a first-rate business plan. This is provided through expert, trainers, coaches and mentors. UST managed to win one of the trophies and was announced as key future business. The competition gained further publicity by the presence of the Minister of State for Energy in the Department for Trade and Industry MP Malcolm Wicks who presided over the award ceremony. The company looked to raise further funding and capital by participating in competitions and winning proof-of-concept awards.

In 2007 UST was short-listed for the Software in Design Award as part of the IET Innovation in Engineering Awards. The Software in Design Award is sponsored by The MathWorks and the software developed by the company is UltraOptimize, the timing analysis and optimization tool for real-time embedded systems. Later this year UST was selected as a finalist in the East of England Development Agency's (EEDA) 'Running the Gauntlet' competition for entrepreneurs and SMEs. 'Running the Gauntlet' is an investment competition and education program which has helped over a thousand companies in the region. Over 300 companies entered the competition with 50 being short-listed and 10 going through to the final including UST. The company's technology and business plan along with its progress demonstrated in the competition managed to receive the interest of serious investors such as CREATE, Low Carbon Accelerator, NW Brown and SEP.

In 2009 UST announced the opening of its new head office at St John's Innovation Centre in Cambridge. The head office will be the commercial centre for the company as well as providing expansion capability for the Technology Development Centre, which is currently at Wivenhoe Park in Colchester. Company Chief Executive Dr Karl Heeks commented "establishing an appropriate head office in Cambridge fits in with our ambitious plans moving forward and it will be the focus of our commercial activity and will complement our established Technology Development Centre in Colchester."

The continuous and successful presence of the company in national research competitions resulted in raising £400,000 of equity investment from the South East Seed Fund, managed by Finance South East, and the Iceni Seedcorn Fund, in 2009 (See 8.Applied Funding Mechanism). The funds are used to develop and market UltraDebug™.

Finally, the development of the technology platform to a licensable product is assisted by an investment of £2million provided by Octupus Ventures (See 8.Applied Funding Mechanism).

It is obvious that UST followed a well-defined and structured business plan in terms of funding and innovation promotion which has led to successful results. The initial research of the project was funded by a government body. Afterwards the company tried to make its business plan and technology known to the market by participating into various competitions which resulted in attracting private investors. Therefore the company managed successfully to shift its funding source from government to private sector.

5.1.2 Socio-economic & Other factors

Other contextual factors such as customer / target market addressed, international validity, customer density, economic conditions, customer values, research area addressed (max 10 lines)

Though still in early development, the first industrial Multiprocessor SOCs have been already used in embedded systems for advanced entertainment and communication platforms and can been found in a set of devices, such as cell phones or portable multimedia players. However this continuous advancement in technology for SoCs, results in novel challenges for system development in the sense that previous used debug strategies for hardware and application software development have either become obsolete, unreliable of insufficient. The impact of product failure on the economy is estimated (2009) to be more that $60 million a year in the USA alone, which much of that money being spent on debugging and verification of embedded systems. Therefore, new and innovative tools should be developed to substantially reduce the cost of product development for companies around the world, since this remains a critical issue.

5.2 Objectives

Aim of the project, specific objectives & strategies to achieve these objectives (max 10 lines)

UST is a pioneering company developing chip design and advanced debugging technology for the embedded electronic systems increasingly used in many everyday products from cars to mobile phones. The company is attempting to exploit research carried out by Professor Klaus McDonald-Maier with Andrew Hopkins and their team. The funds raised by several sources (government bodies, competitions, private investors) are used to develop and market UltraDebug, a multiprocessor, system-on-chip debug support platform. The company claims that when completed UltraDebug will provide superior, application-level, debugging facilities, enabling the embedded systems industry to create more advanced and reliable products in markets such as automotive and consumer devices. Profiling and performance measurements are also aided by UltraOptimize, which supplements the developer's preferred tools. It provides easily accessible visualisations of task execution times and their level of variation when executed in a prototype or final product.

6. Process

Describe the project including key concepts and the overall approach followed. Indicate project end users, target market, main project phases, problems encountered and solutions, problem resolution (max 10 lines)

UST signed a license agreement with the University of Kent in 2006, for exclusive access to a portfolio of patents and patent applications based on the work undertaken by Prof. Maier and his group while at the department. Included in the portfolio are patent applications on debug support interfaces for ICs, on debug condition detection, and on a "bridging architecture for multichip semiconductor component".

UST managed to raise initial funds (SEPOC and PoCKeT) and developed successfully proof-of-

concept prototypes. The company tried to publicize its technology and business plan by participating into several competitions. This attracted private investors and finally, UST raised £400,000 of equity investment from the South East Seed Fund, managed by Finance South East, and the Iceni Seedcorn Fund. Finally, it successfully completed a series A investment of £2million with Octopus Ventures.

6.1 Project Design

Project design based on targeted market complete understanding, project structure, policies and procedures, management and implementation actions (max 10 lines)

UST's goal is to address a major issue in the field of debugging multicore SoCs. The founders of the company have a deep scientific and research knowledge in this particular area and have managed to create and implement a well-structured project plan. UST exploits publicly funded university research and in combination with significant private funds aims to deliver a technological platform that provides a solution to a specific problem. In addition, the interest of private investors was raised not only by the attractiveness of the proposed technology, but with the successful participation in competitions and the completion of proof-of-concept projects.

6.2 Project Management

Activities relevant to project coordination and management, project documentation and reporting, quality control, validation and verification (max 10 lines)

The people who are responsible for management and coordination are listed below:

- Dr S. Karl Heeks, CEO and co-founder
- Pr. Klaus D Mcdonald-Maier, CTO and co-founder
- Dr. Andery Hopkins, VP Engineering
- Mr Andew Bower, Head of Software

Dr. S. Karl Heeks and Dr Klaus D Mcdonald-Maier are also members of the board along with Dr. John Read who is the representative for Iceni and South East Fund Managers and serves on the board as a Non-Executive Director. Furthermore, Dr Luke Hakes who is the representative for Octopus Investments and Dr Jalil Oraee who is the founder of Oxford Semiconductor are external observers of the board.

6.3 Project Implementation

Main elements associated with the project implementation. Realization of new idea, or new technological realization or improvement / novelty to known technology and means to achieve this. Innovation associated with the project realization in terms of new products, services, methodologies. Marketing, advertising and customer service. (max 10 lines)

With each successive generation of integrated circuit (chip) technology the internal clock frequency almost doubles as does the number of transistors. As a result, the circuit activity that needs to be traced increases fourfold with each generation. The speed of electrical device pins, the chips' external debug connections, is increasing at a much slower rate than the speed of chip internal circuits. As a result, with each new chip generation, the requirement for testing quadruples, whilst the debugging capability remains virtually unchanged. The obvious solution of increasing the number of trace pins has very high cost implications, estimated at $4.6million per 10M product units sold. Dr McDonald-Maier of the Department of Electronics, University of Kent, and his team developed a solution that uses optical interconnects combined with dedicated infrastructure circuits, to provide more than

double the current debugging performance. As the performance of optical interconnects greatly exceeds that of conventional electronics, the solution is scalable with new chip generations. Despite huge market potential, semiconductor vendors are very conservative and require demonstration of this concept before investing.

UST signed a license agreement with the University of Kent for exclusive access on the patents or patent application based on the work of Dr. McDonald-Maier. UST was obliged to further develop the technology, provide prototype hardware and demonstrate the suitability of the concept to potential investors and licensees. However, UST's products are not yet available to the market and the company has not revealed much about the characteristics since the project is still under development.

6.4 Project Evaluation

Project feedback mechanisms and evaluation mechanisms. (max 10 lines)

UST proved the validity of its technological platform by accomplishing to deliver on time commercial prototypes in the context of proof-of-concept projects (PoCKeT and SEPOC).

As mentioned above UST has participated into many competitions and has received significant awards.

UST Technologies has been tipped as a key future business winning a trophy and £10,000 in the prestigious Research Councils UK Business Plan Competition 2005-2006. The competition had been running over the last 12 months and started with around 140 entrants from universities, higher education institutions and government funded research laboratories throughout the UK. The finalists were praised on the quality of their business propositions.

In 2007, UST was selected as a finalist in the East of England Development Agency's (EEDA) 'Running the Gauntlet' competition for entrepreneurs and SMEs. In the same year, the company was short-listed for the Software in Design Award as part of the IET Innovation in Engineering Awards

Moreover it was awarded a Grand for Research and Development – Research Grant from the East of England Development Agency (EEDA), in 2010. The grant part-funded an eight month project, of value up to £115k. The project, which was supposed to assess the technology and commercial feasibility of an innovative high capacity trace system which will be a key part of UTS's debugging platform, was finished successfully ahead of the original time schedule.

7. Description of Research team/Institution

Short description of R&D team and institution (max. 10 lines)

The R&D team of the company consists mainly of the following persons:

- **Dr. S. Karl Heeks, CEO and co-founder.** Dr Heeks has spent around 20 years in senior technical and commercial roles within blue chip organisations, SMEs and start-ups. He is experienced in technology development and commercialisation including licensing and general management in high technology in Europe, USA and Asia. Previously he was Director of Business Development at Cambridge Display Technology Ltd where he was part of a small team which won many prestigious awards including the highest ranking UK Company in the Delloite and Touché Fast 500 in 2002. Karl's commercial expertise is complemented by a strong engineering background. He is an inventor on over 30 granted and pending patents worldwide and has been awarded the Royal Academy of Engineering's Gold MacRobert Award for 'outstanding innovation in engineering'. He has BSc and PhD degrees in Chemistry and Chemical Physics.

- **Prof. Klaus D Mcdonald-Maier, CTO and co-founder.** Pr. Mcdonald-Maier leads the technical development program at UltraSoC. He is internationally recognised as an expert in embedded

systems and Systems-on Chip technology. He is a Professor in the School of Computer Science and Electronic Engineering at the University of Essex and has held academic positions at the University of Kent and the University of Jena. Previously at Infineon Technologies AG he was responsible for the architecture specification of advanced SoC processor cores, and modules. Klaus McDonald-Maier has authored over 150 papers and holds 12 patents granted and pending worldwide. He is a Fellow of the IET and a senior member of IEEE.

- **Dr. Andrew Hopkins, VP Engineering.** Dr Hopkins leads the development of UltraDebug™ and an associated technical marketing package. He is experienced in all aspects of computer architecture including SoC design, system level development support and embedded systems engineering. He has managed large multi-institution engineering programs with elite international partners. He has 4 patents pending, numerous technical publications and has served as a referee for several IEEE, IET and Elsevier journals. Andrew obtained a top first in Computer System Engineering from the University of Kent in 2003 where he also took the IEE (IET) prize for the highest placed BEng.

- **Mr. Andrew Bower, Head of Software.** Mr. Andrew Bower leads the development of the UltraDevelop™ IDE software which supports the UltraDebug™ platform. Andrew is a skilled project manager with 8 years experience in embedded engineering, debug tools and silicon testing and has worked in Europe and the Far East. His career in the semiconductor industry began in 2001 at Digital Communication Technologies Ltd and more recently he was a senior staff member developing core software and customer integration projects for multimedia coprocessors at Broadcom Europe Ltd. Andrew has a BA in Computer Science from Gonville and Caius College, Cambridge.

In addition, the company uses the consulting services offered by:

- **Mr. Steve Barlow** . Steve is an electronics and software development veteran with over 25 years experience developing cutting-edge technology. He co-founded Alphamosaic, the video start-up, in 2001 which was successfully sold to Broadcom in 2004 for US$123M after which he stayed on as Senior Director of Engineering developing their next generation video solution with a team of 80 staff. Prior to this he spent 16 years at Cambridge Consultants where he was an Associate Director and leader of the Embedded Digital Systems group, developing a variety of innovative products. Steve has a starred first in Electrical Sciences from Emmanuel College, Cambridge.

- **Mr. Stuart Jobbins** . Stuart has over 26 years experience in software system development and technical management in embedded systems in a broad range of backgrounds including industrial, defence, automotive and aerospace. He has held senior technical positions at Siemens and Delphi and is currently Chief of Software Engineering and Head of the Software Centre of Excellence at Rolls Royce.

8. Applied Financial Mechanism

Describe financial mechanisms applied in transformation of research into innovation within BP, as well as means of connecting scientific research team and financiers (max. 1000 char.)

UltraSoc was spun-out from the universities of Essex and Kent in 2008 after being founded by Cambridge entrepreneur Dr Karl Heeks and Professor Klaus McDonald-Maier, Research Director at the University of Essex's School of Computer Science and Electronic Engineering.

The core technology used by UltraSoc was initially supported by substantial funding from the Engineering and Physical Sciences Research Council (EPSRC), which provided approximately £2million during the research stage.

EPSRC is the main UK government agency for funding research and training in engineering and the physical sciences, investing more than £850 million a year in a broad range of subjects – from mathematics to material science, and from information technology to structural engineering.

Finance South East's PoCKeT and SEPOC provided adequate funding mechanisms to support the

development of proof-of-concept prototypes for the commercial automotive market.

In 2009 seed funding worth £400,000 was secured from the South East Seed Fund and Iceni Seedcorn Fund which allowed the company to open an office in Cambridge and progress the research work into a technology demonstrator.

Finance South East (FSE) is a not-for-profit organisation working with partners from both the private and public sectors to deliver a unique funding service to high growth companies operating across the South East. It is authorised by the Financial Services Authority (FSA) and backed by the South East England Development Agency (SEEDA). The organisation helps ambitious companies to grow through direct investment and associated support. FSE has a strong track record of achieving significant results through relatively small investments. An economic impact study in 2009 found the companies that FSE invested in grew almost five times faster than the national average. Finance South East's specialist range of products and services include advice on funding strategy, introductions to funding sources, fund management, mentoring and investor networks. Finance South East has already helped companies in the region raise in excess of £20million.FSE has a unique business model. Whilst its funds are managed on a commercial basis to meet investor requirements FSE is a not-for-profit entity that does not distribute surpluses. With offices in Camberley and Ipswich, the organisation works across the South East of England and surrounding areas. The team has won many awards for its innovative approach to funding SMEs.
The South East Seed Fund is actively open for business and continues to seek innovative early stage companies that demonstrate the potential for growth. This £7.1m equity fund invests between £100,000 and £250,000 on a 'matched-funding' basis in small and medium-sized enterprises based in the South East, which may include university spin-outs.

The Iceni Seedcorn Fund was established under the University Challenge Fund scheme to help commercialise innovation and technological development derived within the partner institutes; the University of East Anglia, the University of Essex, the John Innes Centre, the Sainsbury Laboratory, the Institute of Food Research, and Plant Bioscience Limited. The Fund was established in 2002 and to date has invested in ten spin-out companies and licensing opportunities.

In 2010 UltraSoC Technologies, announced the successful completion of a series A investment of £2million with Octupus Ventures. The investment will help develop the technology platform to a licensable product. This will involve the expansion of the technical and marketing capability in Cambridge.

Octupus Ventures is an award-winning early-stage investing firm in the United Kingdom. Its model is unique in that it prefers to back exceptional entrepreneurial teams rather than specific sectors, and co-invests with a private investor group, Octupus Venture Partners, in every investment. The group of private investors is made up of 110 scientists, entrepreneurs, businessmen, and leaders of commerce who can add value to the companies they back.

9. Impact and benefits
Describe achieved benefits of R&D team and/or enterprise implemented innovation, as well as impacts on institutional and policy levels. (max. 1000 char.)

UltraSoc is creating software and hardware to support the development of embedded systems that will allow a significant reduction development time for embedded SoCs as well as a safe and efficient configuration that will facilitate the usage of lower specification and reduced cost SoCs. These are significant commercial advantages due to the volume of the market for such embedded systems. As part of the development of the technology platform, UST needed to develop a number of software tools to support the development fro real-time embedded systems on a chip. With one such tool it was necessary to build a proof-of-concept version for the commercial automotive market. The funding tool to accomplish this was Finance South East's PoCKeT fund.

PoCKeT funded a project undertaken at the University of Essex where Dr McDonald-Maier is a Reader and has set up a research group focused on embedded systems and related technologies.

This work involved research at the University of Essex and included an industrial evaluation of the tool as well as its build. Development work to date has already resulted in improved debugging tools, testing methods and technologies that till lead to significant cost and safety improvements in many computer systems within devices such as mobile phones, washing machines and motor vehicles.

10. Sustainability

Provide information on sustainability of innovation after financial aid within implemented financial mechanisms, and some multiplier effects as replication and extension of the action performed in BP. Expected use of Best Practice and lifecycle considerations. (max. 1000 char.)

According to FSE, the company seeks to invest only in opportunities which it believes have the highest potential for success and a set of investment criteria have to be fulfilled. UCT received the fund in 2009. The criteria are:

- A critical technology has been demonstrated

- A coherent business plan has been produced that includes identification of a specific market that has been assessed for feasibility

- The route to full commercialization is clearly defined.

Moreover, according to FSE the following prospects exist:

- There is a significant potential for growth (in sales, profits and shareholder value) based on a clear strategy and a scaleable business model)

- There is a clear and realistic exit strategy for investors within 3 to 5 years.

Furthermore, the management team has successful track record within the relevant industry and in bringing new products to market.

UltraSoC CEO Dr Karl Heeks commented:

 "We are delighted to have both the Iceni Seedcorn Fund and Finance South East involved in this funding round. We are particularly gratified that the quality and promise of our technology and strength of our team has enabled us to secure this funding in such a challenging investment environment."

Sally Goodsell, CEO of Finance South East commented:

"This builds on our long-term relationship with UltraSoC and proves the concept of our South East Funding escalator. We have been supporting the company right from its early proof of concept activities through our PoCKeT and SEPOC Funds. All of us at Finance South East are delighted that the South East Seed Fund is helping to support the next stage of their development. "

Julie Silvester, Fund Manager at Finance South East added:

"This is the first university related deal that we have completed and we are keen to fund more businesses like UltraSoC that have high potential for growth. We really believe in the team and are delighted to provide seed funding to enable them to embrace an exciting market opportunity."

Concerning the Octopus investment Karl Heeks, CEO of UltraSoC, commented:

"We are delighted to have closed this series A investment with Octopus and believe that their experience and contacts, as well as their funding, will bring much additional value to our Company."

Luke Hakes, from Octopus, commented:

"UltraSoC epitomises the type of early-stage business we are looking to partner with at Octopus. The core team and its advisory board are of an exceptional standard and they have the drive and ambition we search for in our own staff. We believe they are capable of delivering a world class, market-changing product that will be very difficult to displace. We are looking forward to working with the

team to help them achieve this goal."

Sally Goodsell, CEO of Finance South East commented:

"We are pleased to see the funding progress UltraSoc Technologies has made from FSE's input at the early proof of concept stage to securing series A funding from Octopus Investments. UltraSoc has proved that even in a challenging investment environment there is support and recognition for innovative, high growth companies and University spin--outs, a message that needs to be relayed to businesses that are currently unaware of the funding options available."

11. Repeatability and transferability

Lessons learned from the project implementation team. Repeatability and transferability of the project. (max. 1000 char.)

UST is a great example of commercialization of R&D results through a start-up company. The company was initially funded by FSE, which is focused only in South East England. The company promoted its research by participating in several research competitions and was awarded in some occasions. Therefore it managed to attract investors and simultaneously acquire additional funds. The exploitation of different funding mechanism constitutes a great practice which can ensure the sustainability of a project.

12. Evaluation

Describe reasons and evaluation criteria why the described example is a best practice. (max. 1000 char.)

This BP is an excellent use case where academic research is transformed to an industrial product.

The project tackles a fully defined problem in a well-know area of embedded systems. The urge for new and innovative tools to substantially reduce the cost of product development for companies around the world, guarantees the utility of the proposed technological platform. The successful participation of the company in several competitions proves the validity of its business plan and the importance of the technology introduced.

UST has already delivered commercial prototypes which prove the viability of their products. However the company has not released any product in the market and thus the commercial success of the project cannot be fully evaluated. Given the fact that the company has announced the commercial deliver of its products in a few months and the absence of efficient alternative solutions in the area of debugging multicore SoCs, the expectations remain high.

UST secured grants from different funding mechanisms in order to develop debugging tools for embedded development systems. Moreover, the company managed to secure significant financing throughout its whole development process showing the quality of the technology and the team involved. Furthermore it is quite astonishing the fact that the company succeeded in obtaining £2million in the current economic climate. The scale of the secured financial support guarantees the financial sustainability of the project.

13. Contact of research team/institution	14.Contact of financial mechanism facilitator
Name, address, tel., fax, e-mail, URL	*Name, address, tel., fax, e-mail, URL*
UltraSoC Technologies Ltd	Finance South East Ltd

St John's Innovation Centre Cowley Road Cambridge CB4 0WS United Kingdom Tel. +44 (0) 1223422133 Fax. +44 (0) 1223 420252 enquiries@ultrasoc.com	Riverside House, 4, Meadows Business Park, Station Approach, Blackwater, Camberley Surrey GU17 9AB United Kingdom Tel: +44 (0) 1276 608510 Fax: +44 (0) 1276608539 Donna.Cooper@financesoutheast.com