Date of Submission

July 2016

Network Innovation Allowance Close Down Report

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Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

Project Progress

Project Title		Project Reference
DISCERN Knowledge Transfer		**NIA_SSEPD_001**
Funding Licensee(s)	**Project Start Date**	**Project Duration**
Southern Electric Power Distribution	February 2013	3 years 3 months

Nominated Project Contact(s)

David MacLeman

Scope

This NIA DISCERN Knowledge Transfer project ran for 3 years 3 months to mirror the duration of the European FP7 DISCERN (Distributed Intelligence for Cost-Effective and Reliable Distribution Network Operation) collaborative project.

The NIA project facilitated Southern Electric Power Distribution's (SEPD) participation as a partner in the EU FP7 DISCERN project, providing access to the significant resources represented by the project participants themselves and the broad range of solutions implemented by DNO/DSOs in their demonstration site projects. SEPD's participation drew on the New Thames Valley Vision (NTVV) LCNF Tier 2 project.

Various monitoring systems, including communications and algorithms, were installed at the demonstration site locations within the DNO/DSO participant networks prior to project commencement, and further additional installations were undertaken within the scope of DISCERN. The EU FP7 DISCERN project was designed to build on these implementations by collating information on the systems and devices used; investigating the replicability and scalability of the solutions implemented; developing an understanding of optimal solutions; investigating the associated costs; making recommendations to a range of stakeholders; and providing communication tools to facilitate the replicability of the solutions.

SEPD's role was to provide data and information, inform project direction, and contribute to the development and review of project outputs. Rather than funding the installation of equipment, the NIA funding facilitated this participation.

The EU FP7 DISCERN project consortium had 11 project partners, comprising five major DNO/DSOs, technology providers, research institutes and technical consultancy.

Objective(s)

The objectives of SEPD's participation in DISCERN were:

- Knowledge relating to a range of Smart Grid sub-functionalities obtained from other partners' research & demonstration sites and from simulations, provided through DISCERN deliverables and simulation outputs
- Increased understanding of how much intelligence to incorporate on a distribution network and the replicability & scalability of solutions across different networks, provided through DISCERN deliverables and simulation outputs
- Development and experience of implementing Use Case & SGAM methodologies and related design tools such that these can be applied within the business beyond DISCERN use and contribution can be made to GB industry discussions on SGAM use; development and experience of implementing a comprehensive semantic model
- Representation of GB DNO interests within the European FP7 project, provision of GB relevant networks for simulation modeling, and feeding relevant developments and information on the direction of work undertaken in Europe to GB industry bodies

Success Criteria

The DISCERN Knowledge Transfer project is to be considered successful where:

- studies and research directly relevant to SEPD, which is beyond the scope of areas to be addressed within NTVV, is made available for incorporation into both business and innovation strategic thinking
- knowledge relating to a range of Smart Grid sub-functionalities not yet being investigated within the business is made available from the demonstration sites and simulations undertaken by EU FP7 DISCERN project partners, supporting decisions on how networks are built, managed and operated
- knowledge of such factors as systems architecture, Use Cases & SGAM, semantic models and CIM, is improved across operational and innovation areas of the business, as well as ICT, such that it is possible to take a view on the potential development, relevance and applicability of such approaches within the business from a BAU perspective
- SEPD has successfully met all of its obligations as a project partner to the EU FP7 DISCERN project, and ensured that project outputs do not go against GB interests, specifically those forming recommendations to standards authorities

Performance Compared to the Original Project Aims, Objectives and Success Criteria

The EU FP7 DISCERN project officially closed on 31 April 2016. The external dissemination 'Final Event' of the EU project was held on 2 June 2016 in Frankfurt.

In keeping with the EU FP7 DISCERN project, the NIA DISCERN Knowledge Transfer project continued to progress well and has reached a successful conclusion, with project outputs well received by external parties and the European Commission.

The aims of the EU FP7 DISCERN project were to investigate the optimal level of intelligence on the distribution network, and to assess technological options that will allow cost-effective and reliable observability and controllability of the future distribution networks in Europe on a replicable and scalable basis.

There were no project partners for the NIA DISCERN Knowledge Transfer project, however, the EU FP7 DISCERN project comprised a consortium of 11 partners from 4 European countries, as listed in Table 1 on the following page.

Table 1 - EU FP7 DISCERN Project Partners

DNO/DSO Partners	
Iberdrola	Spain
RWE	Germany
SEPD	UK
Unión Fenosa Distribución	Spain
Vattenfall	Sweden
Technology Provider Partners	
ABB	Sweden
ZIV	Spain
Consultancy Partner	
DNV GL	Germany
Research Partners	
CIRCE (Research Centre for Energy Resources & Consumption)	Spain
KTH (The Royal Institute of Technology)	Sweden
OFFIS (Oldenburg Institute for Information Technology Tools & Systems)	Germany

At project outset, the high-level Smart Grid services defined by the EU Commission Smart Grid Task Force were reviewed, and the Smart Grid sub-functionalities chosen for investigation within DISCERN were:

- B6 - Enhanced monitoring and control of MV/LV network
- B7bd - Real time monitoring of LV grid
- B9a - Optimised AMR data collection and analysis using virtualised as well as physical concentrators
- B9b - Calculation and separation of non-technical losses
- C12b - Aggregating flexible loads for power flow control and congestion management - simulation only
- C12c - Use of flexible storage for power flow control ancillary service - simulation only

Various monitoring and control systems were installed at innovation project demonstration sites within the DNO/DSO participant networks prior to project initiation, and further additional installations were undertaken within the scope of the EU FP7 DISCERN project.

SEPD drew on learning and experience gained from the monitoring and analysis aspects of the NTVV LCNF Tier 2 project, reflecting sub-functionality 'B7bd - Real time monitoring of LV grid'. The full suite of innovation projects that provided input to the EU FP7 DISCERN project are as follows:

- Iberdrola - PRICE[1], Madrid and Guadalajara area, Spain
- RWE - Smart Country[2], Bitburg and Smart Operator[3], Augsburg/Kisselbach, Germany
- SEPD - NTVV[4], Bracknell, UK
- Unión Fenosa Distribución - PRICE, Madrid and Guadalajara area, Spain
- Vattenfall - Smart Grid Gotland[5], Gotland, Sweden

DISCERN has used the expertise of project partners together with data and information available from the demonstration sites to undertake a range of investigations, studies, modelling simulations and assessments to

[1] PRICE - www.igreengrid-fp7.eu/spain
[2] Smart Country - www.rwe.com/web/cms/de/683570/smart-country (German language website)
[3] Smart Operator - www.rwe.com/web/cms/de/1943232/rwe-deutschland/energiewende/intelligente-netze/smart-operator (German language website)
[4] NTVV - www.thamesvalleyvision.co.uk
[5] Smart Grid Gotland - www.smartgridgotland.se/eng

evaluate the range of technological solutions considered within the project.

Through a suite of 11 Work Packages, the project has collated information on the systems and devices used by project partners to implement the DISCERN Smart Grid sub-functionalities; investigated the factors affecting the replicability and scalability of the solutions implemented; investigated the associated costs; reviewed the commercial and regulatory aspects of different network contexts; developed tools to assess technical and architectural approaches for developing effective and optimal Smart Grid solutions; and made recommendations to a wide range of Smart Grid stakeholders.

The DISCERN Work Packages (WPs) and their project deliverables are listed in Table 2 below, categorised by their European project activity types. The 'Other Specific Activities' and 'Management of the Consortium' category Work Packages were funded in their entirety through the EU FP7. All other Work Packages were 50% funded through the EC FP7, with the balance provided originally through the IFI prior to the DISCERN Knowledge Transfer project's transition to NIA.

Table 2 - EU FP7 DISCERN Project Work Packages

Research and Technological Development	
WP1	Architectural Options and Definitions of KPIs (Key Performance Indicators)
WP2-3	Distributed Devices Functionality/Communication Infrastructure
WP4	System Integration Concept/SCADA[6] Compatibility/Other Enhancement Functions
WP5	Operational Process Integration Concept/Technical Specifications
WP6	Technical Evaluation and Replicability Assessment of the Solutions
WP8	Economic Viability, Business Cases, Recommendations
WP11	Methodologies for Reusing and Comparing Information about Smart Grid Projects
Demonstration	
WP7	Field Tests at Existing Demonstration Sites
Other Specific Activities	
WP9	Dissemination and Exploitation of Project Results
Management of the Consortium	
WP10	Project Management

The project was conducted through meetings, workshops, conference calls and web conferences, in addition to direct emails and phonecalls between individual project partners as required. Data and information were provided directly, or through structured questionnaires and interviews developed to elicit relevant material. All project partners also undertook research, analysis and review activities independently, and those responsible for developing tools and assessment methodologies, or preparing reports, worked closely with other partners to trial and enhance the material produced through feedback received.

SEPD's role was to provide data and information, inform project direction and the development of the methodologies to be applied, and contribute to the development and review of project outputs across the full suite of DISCERN Work Packages. Rather than funding the installation of equipment, the IFI/NIA funding facilitated this participation.

By leveraging the work undertaken in the NTVV project, SEPD's contribution to DISCERN has provided access to the significant resources represented by the project participants themselves and the broad range of solutions implemented by DNO/DSOs in their demonstration site projects.

The tools and templates developed within DISCERN also meet the requirements for an NTVV deliverable relating to the provision of tools for evaluating and comparing solutions trialled in other innovation projects implemented within SSEPD or by other DNOs.

[6] SCADA - Supervisory Control and Data Acquisition

The website developed for the project, www.discern.eu, provides information on the objectives and work plan for the EU FP7 DISCERN project, and has been maintained throughout the project to present the deliverables, tools, publications and final report created to document project activities. This will be active for 2 years beyond the project close down date.

The following sections present the project's performance against its Objectives and Success Criteria.

Objective 1 - Knowledge relating to a range of Smart Grid sub-functionalities obtained from other partners' research & demonstration sites and from simulations, provided through DISCERN deliverables and simulation outputs

A wealth of information has been generated through the DISCERN project, reflecting the learning drawn from both the solutions implemented by European project partners and the simulations undertaken to investigate the DISCERN sub-functionalities listed above.

The detailed deliverables from each of the Work Packages are freely accessible to all interested parties via the DISCERN website www.discern.eu/project_output/deliverables.html. These cover a wider variety of activities, including the use of KPIs to assess the solutions and simulations, reviews of the communications standards and protocols used, and assessments of the strengths and weakness of solutions and factors affecting their scalability and replicability. However, the deliverables that relate specifically to the Smart Grid solutions deployed within the EU FP7 DISCERN project demonstration sites and to the simulation studies undertaken are as follows:

- DISCERN D4.1 Identification of Present System Architecture
- DISCERN D4.2 New System Functionality
- DISCERN D6.2 Simulation Test of DISCERN Solutions
- DISCERN D6.3 Communication Infrastructure Simulation and Assessment
- DISCERN D7.2 Monitoring and Testing Report: The Lessons Learned from the Field Tests

The core Final Report and three associated Booklets summarise the project as a whole, and act as signposts to the detailed deliverables. This material has been published in hard copy and is available electronically via the DISCERN website www.discern.eu/project_output/finalreport.html.

The Use Case Management Repository (UCMR) created during the project is available to project partners and other DNO/DSOs to review the architectures of the solutions deployed within DISCERN. The UCMR is a web application to store and manage Use Cases, Smart Grid Architecture Model (SGAM) representations, and libraries of components, functions and requirements. The database allows users to import, edit and export Use Cases, and presents the associated architectures in a 3D SGAM visualisation tool. This facilitates collaboration between departments or organisations when designing a new solution, but also provides a reference source for assessing and learning from solutions implemented by other organisations to achieve a specific goal or deliver a specific functionality.

The UCMR is hosted by European project partner OFFIS, and can be accessed via http://ucmr.offis.de, where registration information is also provided. A User Guide for the UCMR is available via the DISCERN website:

- DISCERN Use Case Management Repository User Guide

The DISCERN consortium has recommended that the EC supports the further development and upkeep of the DISCERN UCMR database.

The various meetings and workshops held during the course of the project also provided opportunities for project partners to visit the demonstration sites of the participant DNO/DSOs, and to learn of partners' wider innovation activities and business as usual approaches to operating and managing their networks. For example, the WP7 workshop hosted by Vattenfall on the Swedish island of Gotland allowed SSEPD staff directly involved with the planned 'A New Energy Solution for Shetland' project to see the technologies being trialled within the Smart Grid Gotland project, and discuss the project and the solutions with the Smart Grid Gotland project team. Like Shetland, as an island network there is a focus on balancing generation and demand across Gotland. The Smart Grid Gotland project aims to increase hosting capacity for renewables, improve quality of supply to customers, and create market opportunities for demand side participation in the energy market to shift load patterns.

In addition, the good working relationships built during the project have allowed information to be obtained on innovative solutions beyond the scope of DISCERN, which have been used to inform other projects within SSEPD. Examples of such extramural information exchange and interaction include:

- trilateral discussions between SSEPD, EATL and Iberdrola on the use of Power Line Carrier (PLC) technology with respect to SSEPD's I^2EV LCNF Tier 2 project;
- the provision of information on the benefits and constraints of different baseline methodologies for assessing the impact of demand reduction events, as used to develop the approach applied for SSEPD's introduction of Constraint Managed Zones (CMZ); and
- expert guidance on using the CIM2Matpower tool developed within DISCERN to import network model CIM (Common Information Model) data into Matpower for modelling and power flow analysis, supporting the NPL (National Physical Laboratory) in leveraging NTVV network models and LV monitoring data to investigate optimal levels of distribution grid monitoring as part of the EU funded EMRP (European Metrology Research Programme) Joint Research Project GridSens[7].

Such aspects are also referenced where relevant in the sections below.

Objective 2 - Increased understanding of how much intelligence to incorporate on a distribution network and the replicability & scalability of solutions across different networks, provided through DISCERN deliverables and simulation outputs

At the heart of the EU FP7 DISCERN project is the need to change the ways that networks are designed, operated and maintained. Whilst each distribution network across Europe has its own specific characteristics, operators share common aims and challenges.

The activities defined within the DISCERN Work Packages and the diverse range of consortium partners have enabled the development of knowledge and tools specifically designed to support industry participants by informing their decisions on the development of Smart Grids that ensure high security of supply for the future. The tools created have been trialled within DISCERN during the development of new Smart Grid solutions and simulations, and comprise the following:

- Use Case & SGAM Tools
- Standards Assessment and proposed DISCERN IT Security Concept
- DISCERN Semantic Model
- Simulations and the Cim2Matpower Tool
- DISCERN KPI Framework
- Cost Benefit Assessment Methodology

These are introduced in DISCERN Booklet 1 of the Final Report, which also provides references and links to the associated deliverables that document the development of the tools in detail. This Booklet is available via the DISCERN website:
- DISCERN Booklet 1 - DISCERN Tools for Smart Grid Solution Design and Assessment

The tools set out above support the assessment and design of Smart Grid solutions. Methodologies have also been developed for evaluating the replicability and scalability of new technologies to assist DNO/DSOs in understanding and adapting solutions for their own networks.

As one aspect of this, a framework has been created for undertaking qualitative analysis of the replicability and scalability of solutions. This provides a clear approach for highlighting areas where detailed consideration would be of value to an adopting party to ensure the feasibility of scaling or replicating a solution in a different network environment.

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[7] GridSens 'Sensor Network Metrology for the Determination of Electrical Grid Characteristics' - www.gridsens.eu

This framework includes a list of assessment factors which reflect circumstances, characteristics or considerations that will have an influence on the replicability or scalability of a solution. This takes forward work undertaken in the EU FP7 GRID+[8] project, and the series of factors have been developed based on the experiences drawn from consortium partners during DISCERN. These scalability and replicability factors are listed in Table 3 below.

Table 3 - DISCERN Scalability & Replicability Factors

Factors for Consideration	Relevance to Scalability	Relevance to Replicability
Interoperability	✓	✓
Software Design Flexibility	✓	
Interface Design Flexibility	✓	✓
Version Compatibility	✓	✓
Modularity	✓	
Increment on Device/System Inventory	✓	✓
Technical Abstraction (physical characteristics - user experience)	✓	
Simplicity/Ease of Installation & Integration	✓	✓
Availability of Alternatives	✓	✓
Technology Evolution	✓	✓
Cost Effectiveness		✓
Economies of Scale	✓	
Stakeholder Interaction	✓	
Level of Acceptance (amongst all stakeholders)	✓	✓
Regulatory and Legal Issues	✓	✓
Business Model		✓
External Constraints	✓	✓

A Validation Checklist has also been developed as a reference for those adapting a solution when appraising their new design. This is intended to guide the assessment of the new system to confirm that it will meet a full range of requirements. This list is provided in Table 4 below.

Table 4 - DISCERN Replicability Validation Checklist

Validation Checklist
Security
Power System Reliability
Compliance with Regulation
Efficiency
Accuracy
Communications Network Performance
Applicability of Methodologies and Tools (suitability for the new environment)
Selectivity (no inadvertent impact on existing hardware or software)
Controllability
Level of Acceptance

This assessment framework has been applied to provide a qualitative analysis of the replicability and scalability aspects of each solution deployed within DISCERN. No single factor makes the replicability or scalability of

[8] GRID+ **is** a Coordination and Support Action created to support the European Electricity Grids Initiative (EEGI) by organising networking amongst Smart Grid demonstration projects in Europe - www.gridplus.eu

Smart Grid solutions feasible or unfeasible in a different network area, as many factors are interconnected, and the use of this assessment methodology helps to identify the key factors of relevance for consideration by DNO/DSOs looking to implement a solution on their own network.

The deliverable that relates specifically to the replicability and scalability assessment framework is:
- DISCERN D5.2 DISCERN Guide for Facilitating the Replication and Scalability of the Solutions - Chapter 5

The DISCERN consortium recommends that DNO/DSOs leverage the list of identified key factors that affect the replicability and scalability of Smart Grid solutions for assessing future deployments.

As a second aspect relating to the adaptation of solutions for different network environments, a SWOT (strengths, weaknesses, opportunities & threats) analysis framework has been created to identify the advantages and disadvantages of various approaches. This provides a systematic means of assessing the internal strengths and weaknesses, and external opportunities and threats of a system or solution, such that these can be understood and managed. Each layer of the SGAM framework is considered to provide a clear and comprehensive appraisal of a solution. In addition to wider factors and influences, the use of this approach in DISCERN has demonstrated its value in identifying aspects suited to centralised or decentralised control, comparing options for communication media, understanding requirements for device data storage, etc.

The deliverable that relates specifically to the DISCERN SWOT analysis is:
- DISCERN D8.2 SWOT - Analysis of Applied Technologies and Solutions

Time and resource constraints experienced by the European project partners responsible for the DISCERN simulation activities, together with some confidentiality issues raised by other European DSO project partners, prevented the modelling & simulation project partners from running the 'Optimal Placement of Devices in LV Electrical Distribution Networks' simulations on the SEPD network model as originally planned. Rather, these were run on a generic network model based on the CIGRE LV benchmark grid adapted to reflect comments provided by DISCERN project partners, including SEPD. The use of this generic network model provided outputs which met the criteria required for the project deliverables. Further, the network model CIM data provided by SEPD allowed the development of the DISCERN CIM2Matpower tool. Beyond DISCERN, and as referenced above, this DISCERN CIM2Matpower tool has been shared with the NPL (National Physical Laboratory) together with SEPD network model CIM data available from the NTVV project. These project outputs have been shared with the NPL to contribute to their research into optimal levels of distribution grid monitoring as part of the EU funded EMRP project GridSens. This opportunity for knowledge and data sharing was identified through a conversation on research activities between SSEPD and the NPL during the 2014 LCNI Conference, and provides a further route by which learning from innovation projects can be leveraged.

The deliverable that details the approach used to undertake the 'Optimal Placement of Devices in LV Electrical Distribution Networks' simulation studies is:
- DISCERN D6.3 Communication Infrastructure Simulation and Assessment

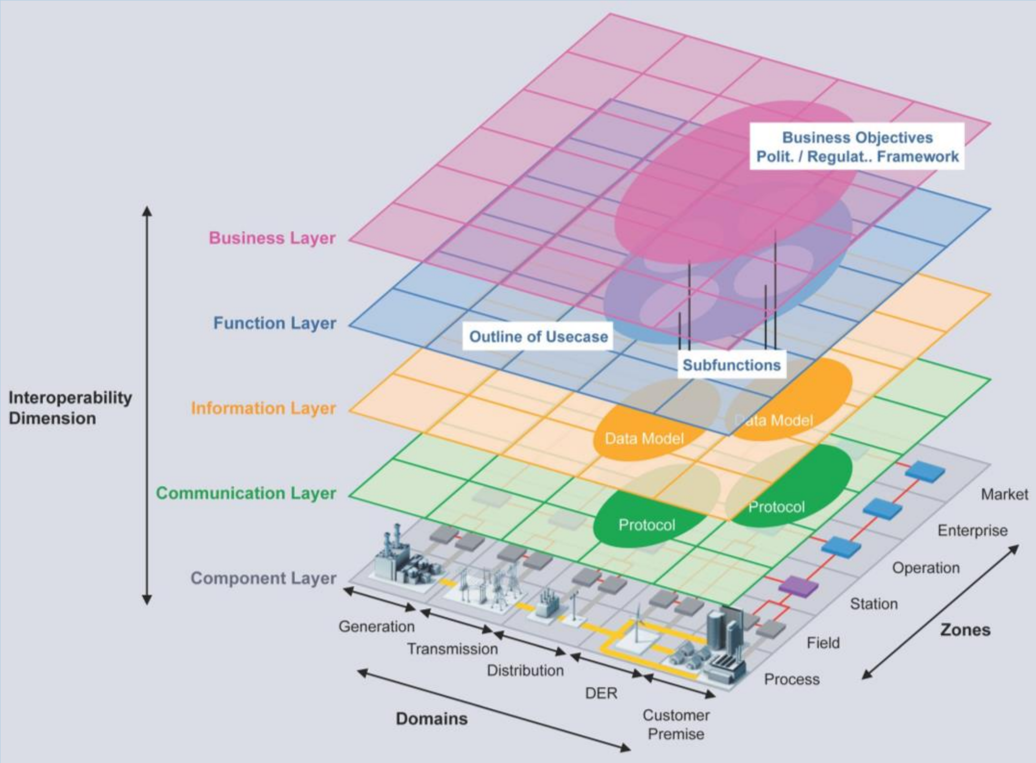
In addition, two academic papers referencing the use of SEPD data have been written by DISCERN project partner KTH and are available in the publications section of the DISCERN website:
- Facilitating Distribution Grid Network Simulation Through Automated Common Information Model Data Conversion - presented at the 2015 PowerTech Conference, Eindhoven, Netherlands
- A Method to Identify Exposed Nodes in Low Voltage Distribution Grids with High PV Penetration - presented at the 2015 IEEE Power and Energy Society (PES) General Meeting, Denver, USA

Objective 3 - Development and experience of implementing Use Case & SGAM methodologies and related design tools such that these can be applied within the business beyond DISCERN use and contribution can be made to GB industry discussions on SGAM use; development and experience of implementing a comprehensive semantic model

In 2011 the European Commission issued a Mandate (M/490) to standards organisations relating to Smart Grid deployment. In response, the CEN-CENELEC-ETSI Smart Grid Coordination Group (SGCG) created an architectural framework for developing & enhancing standards - SGAM (Smart Grid Architecture Model). Subsequently, a number of wider uses of SGAM have been established, including its relevance in developing and communicating Smart Grid system designs. Allied to this, international standard IEC 62559-2 sets out the formal Use Case methodology.

SGAM is a three dimensional model that reflects principals applied in the well established ICT architecture approaches for designing complex systems in a technology neutral manner. The three dimensional SGAM Framework is presented in Figure 1 below.

Figure 1 - SGAM Framework



The SGAM plane contains Domains that relate to physical levels of the electricity supply chain, and Zones that reflect the hierarchical management aspects of the power system. The SGAM Layers above this contain information on different elements of a system's design, as summarised below:

- Business Layer - representing the commercial entities, their aims and their interactions within the markets in which they operate
- Function Layer - setting out the operational functions of each element of a system or solution
- Information Layer - presenting the information flows needed between the different actors to deliver the solution
- Communication Layer - identifying the standards and protocols required for the system, as key to full interoperability
- Component Layer - defining the physical elements of the system

To allow the solutions of the different European project partners to be compared and analysed, DISCERN required SEPD to translate the monitoring and analysis aspects of the NTVV project design into SGAM, and to create a full, detailed Use Case using a standardised framework and terminology.

To support the project partners in this task, the consortium's Use Case & SGAM experts created a series of tools and templates to allow partners to quickly engage with SGAM and the Use Case methodology, including the following:

- DISCERN SGAM Visio Template
- DISCERN Use Case Word Template
- DISCERN Libraries of actors, technical functions & requirements
- DISCERN Use Case Management Repository

Whilst each of the tools can be used separately for specific purposes, one key feature of the DISCERN Use Case & SGAM tools is their ability to exchange data with each other (and with external applications) via standards-based XML[9] interfaces. This also allows the data to be imported into the UCMR described above.

These tools are freely available to interested parties via the DISCERN website www.discern.eu/project_output/tools.html.

The deliverables that provide detailed information on the development and use of the DISCERN Use Case & SGAM tools are:

- DISCERN D1.3 Architecture Template and Guidelines
- DISCERN D2.3.2 Tool Support for Managing Use Cases and SGAM Models
- DISCERN D2.3.3 Standard Assessment Regarding Devices and Communication Architectures
- DISCERN D.2.3.4 Evolution of Learners' Solutions: from Requirements to Implementation
- DISCERN D4.1 Identification of Present System Architecture
- DISCERN D4.2 New System Functionality

The DISCERN consortium recommends that DNO/DSOs leverage the DISCERN Use Case & SGAM approach and tools to support systems design and grid planning, and to improve communication and collaboration between internal departments as well as with external stakeholders such as product vendors and other DNO/DSOs.

DISCERN represented SEPD's first introduction to SGAM and the standardised Use Case framework, however the tools and templates developed within the project made it very easy to engage with this approach, supporting a very swift learning curve.

Drawing on the experience gained through DISCERN, SEPD has presented on various themes relating to SGAM at a number of UK Smart Grid Forum (SGF) meetings and workshops. Through this, SEPD has become involved in the SGF's Work Stream 9 SGAM working group to advocate and promote the use of SGAM as a tool to drive interoperable Smart Grid deployment within Great Britain. The DISCERN Visio tool has been used for a workshop as part of this work, and the range of DISCERN Use Case & SGAM tools have been introduced.

DISCERN also represented a first introduction to CIM for many of the European project partners. Through workshops and the sharing of relevant material the CIM experts within the consortium provided knowledge of the model's structure, and the use of CIM in a number of activities throughout the project clearly demonstrated its benefits in promoting interoperability that will support the efficient delivery of Smart Grids.

The reference and introductory material recommended by the DISCERN CIM experts to project partners includes the titles presented in Table 5 on the following page.

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[9] XML (Extensible Markup Language) is a text language for data flows

Table 5 - CIM Reference and Introductory Material Recommended by DISCERN CIM Experts

Title	Date	Author	Organisation
'An Introduction to IEC 61970-301 & 61968-11: The Common Information Model'	2007	Alan W. McMorran	University of Strathclyde
available free at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.112.4648&rep=rep1&type=pdf			
'Common Information Model Primer: Third Edition'	2015	Alan W. McMorran et al	EPRI
specifically recommended: Chapter 5 *available free at* www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002006001			
'The Common Information Model CIM IEC 61968 and 61970 - A practical introduction to the CIM'	2012	Mathias Uslar et al	Springer
a draft version of this book was circulated to the consortium by the author for the use of DISCERN project partners only - the published version is available to purchase via various websites			
'Standard 61970-301 - Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM) base'	2013		IEC
specifically recommended: Chapter 4 - available to purchase from https://webstore.iec.ch/publication/6210			
'Standard 61968-11 - Application integration at electric utilities - System interfaces for distribution management - Part 11: Common information model (CIM) extensions for distribution'	2013		IEC
specifically recommended: Chapter 4 - available to purchase from https://webstore.iec.ch/publication/6199			

Further, two spreadsheets containing the CIM information packages (classes and their attributes with descriptions for each package) based on the IEC 61968 and 61970 standards were provided to DISCERN partners to inform project activities.

Using this introductory knowledge, the experiences of the European project partners in implementing Smart Grid innovation projects have been used to elicit potential extensions to CIM, which have been put forward to the IEC TC57 (International Electrotechnical Commission Technical Committee 57), with TC57 Working Groups 13 and 14 being responsible for maintaining the CIM in the context of distribution management systems and energy management systems, respectively.

The DISCERN consortium also makes a recommendation to DNO/DSOs to develop standard profiles for communications and standard data models which will improve interoperability between information and control systems, and to adopt CIM as the data model to promote interoperability in the development of Smart Grid solutions.

Two key deliverables relating to the use of CIM within DISCERN are:

- DISCERN D5.1 Semantic Model to Transfer Developed Solutions to DSOs and to Facilitate their Integration
- DISCERN D5.2 DISCERN Guide for Facilitating the Replication and Scalability of the Solutions

In addition, as it becomes increasingly apparent that the use of standard data models is key to the interoperability that's necessary for Smart Grids, and that part of this is the need to specify the format of the messages that allow information to be exchanged within a solution, DISCERN has proposed a structured approach to automate the use of high-level SGAM models to define specific CIM-based interfaces required for a solution.

This SGAM-to-CIM methodology is a step-wise process to use the intuitive SGAM representations of Smart Grid solutions - which can be easily produced by domain experts within a DSO - to generate the specific CIM-based XML Schemas that define the formats of the messages to be communicated across the system.

The deliverable that relates specifically to the proposed SGAM-to-CIM methodology is:

- DISCERN D5.4 Standardisation Assessment Regarding Canonical Data Models - Section 3.2

Objective 4 - Representation of GB DNO interests within the European FP7 project, provision of GB relevant networks for simulation modeling, and feeding relevant developments and information on the direction of work undertaken in Europe to GB industry bodies

The differences in network topologies and regulatory environments between the European DNO/DSO partners were evident during the project. The participation of a range of partners, including SEPD, allowed different circumstances to be considered within the project, supporting development of deliverables that are widely applicable and reflect aspects of relevance in different environments.

As an EU FP7 funded project, DISCERN reports directly to the European Commission, and makes recommendations to technical, regulatory and standards organisations within Europe.

SEPD contributed actively to all of the Work Packages, ensuring that aspects of relevance to a GB DNO were reflected in the project's work. This included providing verification of and supporting information relating to the benchmark network models developed for use in the simulations, and assumptions used throughout the broader project. This also ensured the inclusion of factors that a GB DNO would need to consider when assessing the scalability or replicability of solutions or undertaking cost benefit analysis.

Further, strong input was provided to the regulatory assessment aspects of the project by the SEPD Regulation team.

SEPD is one of two DISCERN DNO/DSOs to propose an extension to the CIM semantic model. This relates to an 'Energy Storage System' functionality, and draws on the implementation of storage technologies within the NTVV project. A new set of classes are proposed, for addition to the current CIM classes contained in IEC 61968 and 61970 This has formed part of the recommendations made by DISCERN to the IEC TC57 Working Groups 13 and 14. The deliverable that summarises the energy storage system data model is:

- DISCERN D5.2 DISCERN Guide for Facilitating the Replication and Scalability of the Solutions - Section 3.2.2

As referenced above, drawing on the experience gained through DISCERN, SEPD has presented on various themes relating to SGAM at a number of SGF meetings and workshops, and become involved in the SGF Work Stream 9 SGAM working group to demonstrate the value of SGAM and promote its use within GB. As a range of benefits associated with using this approach have been identified beyond those in communicating innovation projects, the working group has made strong recommendations to DECC and Ofgem to promote the use of SGAM across the industry - from utilities companies and product vendors to policy makers and potential investors.

Through DISCERN, SEPD also has an increased awareness of the work undertaken by the European standards organisations (CEN-CENELEC-ETSI, through the SGCG) on mapping over 500 available standards to Smart Grid Use Cases, including their creation of the 'IOP Tool' (interoperability). The IOP Tool is provided as an Excel spreadsheet and presents this mapping of standards to systems for use as a reference tool by those developing new systems. The IOP Tool can be used to identify standards that are relevant to the components of a system under design, and as the tool reflects the structure of SGAM, this can be done effectively and efficiently by filtering against layers, domains and zones. By identifying and specifying standards at this stage, the interoperability of the final system design can be achieved efficiently, and this approach can be promoted within GB as more familiarity is gained with SGAM.

The IOP Tool and accompanying document highlighted to European partners by the DISCERN standards experts are freely available:

- Smart Grid Coordination Group IOP Tool - save as a download or select 'Anonymous' to open directly in the absence of an FTP Log On account
- Smart Grid Coordination Group Standards Report

Success Criteria 1 - studies and research directly relevant to SEPD, which is beyond the scope of areas to be addressed within NTVV, is made available for incorporation into both business and innovation strategic thinking

Success Criteria 1 has been met across a number of activities.

The use of SGAM and the Use Case methodology within DISCERN has highlighted a range of opportunities relating to communicating project requirements and proposals amongst different departments or with external organisations during the design or procurement of new systems or solutions. Further, the Use Case & SGAM tools developed within DISCERN provide effective and intuitive means to engage with and adopt these approaches.

The DISCERN external Vendor Workshop held in December 2014 also elicited very positive feedback from external participants on the use of SGAM and the Use Case methodology as part of the procurement process. This event is documented on the DISCERN website www.discern.eu/events/workshopIII.html.

Based on SEPD's experience and the feedback from attendees at the DISCERN external Vendor Workshop, SSEPD chose to use SGAM as part of the OJEU (Official Journal of the European Union)[10] procurement process for the Constraint Managed Zone[11] schemes being delivered into business as usual, as described under 'Success Criteria 3' below.

Dialogue continues on the business's intentions to make further use of SGAM in a range of activities, as also referenced under 'Success Criteria 3' below.

Further, the benefits demonstrated through DISCERN have led to SEPD becoming involved in the SGF Work Stream 9 SGAM working group to demonstrate the value of SGAM and promote its use within GB.

The use of KPIs to assess the performance of solutions being trialled within DISCERN has provided experience and guidance on the use of this approach, with the material provided for DISCERN project assessment now available for reference when considering the use of KPIs to track performance in innovation or business activities where appropriate.

The knowledge sharing aspects of DISCERN have provided insight into a range of approaches that are useful in disseminating project activities. These include the use of SGAM to represent the solutions deployed, the framework for identifying the replicability and scalability factors important for consideration when adapting a solution to a different network, and the SWOT analysis that provides further insight into aspects that may need to be managed to ensure effective implementation. Rather than simply describing what has been undertaken in a project, each of these approaches provide effective means for communicating the systems implemented and how these integrate with existing assets, and for informing the decisions to be made by others when implementing new Smart Grid functionalities on their networks. These approaches, supported by the guidance material produced within DISCERN, each represent potential options for consideration when disseminating SEPD innovation project activities, and are shaping thinking on what to incorporate in outputs prepared for projects such as NTVV.

The knowledge of CIM provided by DISCERN has clearly demonstrated the value in applying a logical semantic model, such as CIM, to promote interoperability and support the efficient delivery of Smart Grids. To promote awareness and understanding of the potential value and benefits of CIM, the material provided to DISCERN partners by the project's CIM experts has been shared with colleagues from different areas of the business (including with Innovation, ICT and the Data Architects for a new Work & Asset Management project). This contributes to thinking on the development of future business processes as well as innovation activities.

Similarly, as DISCERN has provided an awareness of the European Smart Grid standards mapping IOP Tool, the availability of this tool has been shared with colleagues and project partners as a useful point of reference for

[10] The OJEU is the gazette of record for the European Union used by purchasing authorities to publish tender information, including invitations to tender, prior information notices, qualification systems and contract award notices - www.ojeu.eu

[11] CMZs are defined geographic areas where network requirements related to peak electrical demand under fault conditions are met through the use of demand side response techniques, such as demand reduction or export from storage or generation, provided as a managed service to SSEPD by a CMZ service provider

future innovation and business projects with regard to identifying standards that will support interoperability within systems developed.

The various meetings and workshops held during the course of the project also provided opportunities for SEPD staff to visit the demonstration sites of the participant DNO/DSOs, and to learn of partners' wider innovation activities and business as usual approaches to operating and managing their networks. Of relevance for SSEPD's planned 'A New Energy Solution for Shetland' project, the WP7 workshop hosted by Vattenfall on the Swedish island of Gotland allowed SSEPD staff directly involved with the Shetland Isles project to see the technologies being trialled within the Smart Grid Gotland project and consider aspects that may have value for Shetland.

Further to discussions between DISCERN project partners on the use of PLC, Iberdrola offered to arrange a conference call between their PLC experts and EATL, as project partner for SEPD's I^{2}EV (My Electric Avenue)[12] LCNF Tier 2 project, to discuss the use of PLC technology within I^{2}EV and advise as to what investigations could be done to understand and resolve the technical issues being experienced. In addition to this, Iberdrola have confirmed that they will be happy to support SEPD with further guidance and information in future, should further queries regarding the use of PLC arise within innovation or business activities.

The good working relationships developed within DISCERN have also provided access to information and research regarding the benefits and constraints of applying different baseline methodologies to assess the impact of demand reduction events. A comprehensive review of these has informed the development of a practicable and impartial methodology for calculating the baseline against which a load profile can be compared to ascertain the level of reduction seen during a demand reduction event. This methodology has been incorporated into the contractual arrangements for SSEPD's Constraint Managed Zones. The reports sourced from DISCERN DNO/DSO and Consultancy project partners are listed in Table 6 on the following page.

[12] My Electric Avenue is the public identity for the I^{2}EV LCNF Tier 2 project - http://myelectricavenue.info

Table 6 - Demand Response Baseline Methodology Material Sourced Through DISCERN Partners

Title	Date	Author	Commissioning Body	Format
Development of Demand Response Mechanism, Baseline Consumption Methodology - Phase 1 Results	Jul 2013	DNV KEMA	Australian Energy Market Operator, Project No. 20320008	report
Development of Demand Response Mechanism, Baseline Consumption Methodology - Phase 2 Results	Oct 2013	DNV KEMA	Australian Energy Market Operator, Project No. 20320008	report
PJM Empirical Analysis of Demand Response Baseline Methods	Apr 2011	KEMA	PJM Markets Implementation Committee, Clark Lake, Michigan	report
Energy efficiency and demand management department commercial customer solutions section	Feb 2013	Consolidated Edison Company of New York, Inc.		report
Demand Response Measurement and Verification	Mar 2009	AEIC Load Research Committee		report
Emergency Interruptible Load Service Default Baseline Methodologies		ERCOT		report
Summary of Baseline Assessment Studies - Reference material for Measurement & Verification and Baseline for Demand Response	Jun 2014	Miriam L. Goldberg & G. Kennedy Agnew, DNV KEMA	National Forum on the National Action Plan on Demand Response: Measurement and Verification Working Group	reference document
The Demand Response Baseline	Dec 2008	ENERNOC	Alberta Electric System Operator - Demand Response Working Group	white paper
DRIP Action B3 - Report on interruption campaigns	Feb 2015	RWE et al	EC Life Programme Project - DRIP (Demand Response in Industrial Production)	report
Assessment of Settlement Baseline Methods for Ontario Power Authority's Commercial and Industrial Event Based Demand Response Programs	Sep 2010	Freeman, Sullivan & Co.	Ontario Power Authority	report
Proxy Demand Resources, Full Market Module	Apr 2010	Jenny Pedersen	California Independent System Operator	presentation

Additionally, to inform longer term thinking, the NPL are leading on Work Package 2 ‘Application of Network Observation Algorithms to Real Distribution Grids’ of the EU funded EMRP project GridSens, to investigate optimal levels of distribution grid monitoring. To contribute to their work, SEPD has shared the CIM2Matpower tool developed within DISCERN with the NPL together with NTVV network model and LV monitoring data.

Success Criteria 2 - knowledge relating to a range of Smart Grid sub-functionalities not yet being investigated within the business is made available from other FP7 DISCERN partners' research & demonstration sites and from simulations, supporting decisions on how networks are built, managed and operated

Success Criteria 2 has been met through a range of DISCERN project deliverables.

To allow project partners’ demonstration site solutions to be assessed and compared within DISCERN, the technologies trialled and the architectures used have been documented using the Use Case & SGAM tools developed within the project. In addition to the documents prepared, the UCMR also provides a central repository for the SGAM architectures, including 3D representations of these architectural models.

In addition, the experiences regarding deployment and implementation have been documented throughout the project, including consideration of the factors affecting scalability and replicability and the SWOT analysis of all solutions.

All of this information is available to all interested parties through the DISCERN deliverables, and presents a suite of useful material for SEPD to reference for future work.

Success Criteria 3 - knowledge of such factors as systems architecture, Use Cases & SGAM, semantic models and CIM, is improved across operational and innovation areas of the business, as well as ICT, such that it is possible to take a view on the potential development, relevance and applicability of such approaches within the business from a BAU perspective

Success Criteria 3 has been met, leading to ongoing consideration and discussions within the business on both the use of SGAM and the Use Case methodology and the potential for application of a CIM semantic model.

SEPD’s experience through DISCERN has demonstrated that SGAM and the Use Case methodology can bring a range of benefits to energy system stakeholders and policy makers, all of which stem from SGAM’s strength in promoting communication and understanding. The consistent structure, language and visualisations provide an approach that can be used by all participants and stakeholders to increase understanding of the emerging functionalities and system requirements for Smart Grids. The roles, responsibilities and relationships of the different actors can also be considered.

As this approach encompasses all aspects of a system, from the electrical infrastructure and ICT technology to information flows and market structures, it can add value at many different stages of project design, and has exceptional potential for enhancing the efficiency, quality and cost effectiveness of the delivery of all aspects of Smart Grid development.

SEPD recognises benefits in the following key areas:

- Innovation Rollout - by using SGAM to share innovative solutions it’s possible for other DNOs to analyse and compare solutions, and assess the appropriate adaptations to replicate a solution on their own networks
- System Design - when designing systems its possible to see where new equipment will interface with existing assets and identify synergies to exploit equipment for different Smart Grid functionalities, and the complete set of layers support effective collaboration between all those involved in a system’s design
- Procurement - for procurement, clarity in the specification of complex systems promotes efficiency in the procurement process, allows vendors to understand requirements and supports evaluation of proposals by grid operators
- Interoperability - interoperability is strengthened as the standards and protocols required to implement a solution can be identified and communicated, with the effective use of standards leading to true ‘plug & play’ capability, supporting efficient delivery of Smart Grid solutions
- Creating New Opportunities and Business Models - new opportunities and business models can be created as market interactions and responsibilities can be identified and defined, which can help shape development of the energy markets by policy makers and regulators
- Stakeholder Confidence - stakeholder confidence can be increased through an improved understanding of Smart Grid services, thereby reducing the perceived risk for potential investors, and policy interventions can be assessed and understood as SGAM translates changes to market interactions into functional outcomes

It is also clear that the Use Case & SGAM tools developed within DISCERN provide effective and intuitive means to engage with and adopt these approaches.

Building on the experience gained through DISCERN and the positive feedback received from external attendees to the DISCERN Vendor external workshop, SGAM has been used in the OJEU procurement process for SEPD's CMZ schemes. An SGAM representation of the existing systems was included in the RFI (Request for Information) and ITT (Invitation to Tender) documents, and potential vendors were invited to represent their solutions in SGAM using the DISCERN tools. In addition, the Use Case framework was used to develop a set of questions for inclusion in the tender documents, to elicit useful information with regard to such things as systems interfaces, measurement and monitoring, and system reliability and contingency. Though the level of familiarity with SGAM is relatively low across the industry, four potential vendors chose to represent their solutions or products in SGAM, using the DISCERN tools provided. These SGAM visualisations were incredibly useful in quickly building an understanding of vendor proposals, supporting the technical review of proposals by the project team and helping to identify further questions.

Following this trial of SGAM as part of the procurement process, SEPD are also developing plans to use SGAM within a number of other innovation projects. As two examples, the Low Energy Automated Networks (LEAN)[13] LCNF Tier 2 project plans to use SGAM to develop the system architecture for trial of the LEAN technology on the SEPD network, and the proposed ReZone (Resilient Network Zones)[14] project put forward for the Electricity Network Innovation Competition (NIC) plans to use SGAM to describe the operational and commercial model aspects of the project in the ReZone bid document. SEPD are also looking to represent a number of other innovation projects using SGAM, to draw on its value in communicating such projects to other DNOs, allowing them to understand what's been implemented for a project and to evaluate the adaptations necessary to replicate a solution within their own systems.

Once those models are established, the business would also then look to design the implementation of new innovation projects using SGAM. The availability of existing SGAM representations will allow synergies between solutions to be quickly identified to support the efficient implementation of new solutions, and allow the requirements for information flow, communication standards & protocols to be readily identified.

As the Use Case & SGAM tools developed within DISCERN have proven their value in helping SEPD to engage quickly with SGAM and the Use Case methodology, these activities will be progressed using the DISCERN tools.

During the course of DISCERN a number of sessions have been held with colleagues from outside the DISCERN project team to build knowledge of SGAM within the business. The DISCERN tools have been shared with colleagues, and internal dissemination with regard to SGAM is ongoing beyond the completion of DISCERN.

With regard to CIM, the SEPD project team engaged directly with ICT staff during the DISCERN semantic model work, and this allowed SEPD to propose an extension to CIM relating to Energy Storage Systems.

Building on the experience provided by DISCERN, discussions on the use of CIM as a logical semantic model are ongoing with different areas of the business, including Innovation, ICT and the Data Architects for a new Work & Asset Management project, together with activities to raise awareness of CIM within the wider business. As part of this, the introductory material recommended by the DISCERN CIM experts, as detailed under 'Objective 3' above, has been shared with colleagues from these different teams.

[13] LEAN - www.ssepd.co.uk/lean
[14] ReZone Electricity Network Innovation Competition Screening Submission Pro-forma - www.ofgem.gov.uk/ofgem-publications/100169

Success Criteria 4 - SEPD has successfully met all of its obligations as a project partner to the FP7 DISCERN project, and ensured that project outputs do not go against GB interests, specifically those forming recommendations to standards authorities

The EU FP7 DISCERN project has now successfully concluded, with all project and governance obligations met by SEPD.

SEPD's participation in the project has been well received, with the project team thanked personally for their involvement and contribution.

Further, SEPD has been approached by a number of DISCERN partners with regard to potential collaboration in future innovation projects, including EU Horizon 2020 proposals.

The good working relationships built during DISCERN have provided access to knowledge beyond the scope of DISCERN (such as solutions deployed in European partners' broader innovation portfolios, PLC and demand response baseline calculation) and allowed SEPD to share a number of safety initiatives used within the business with European project partners.

The DISCERN recommendations to standards organisations and regulatory authorities have been influenced by SEPD's contribution to the project, and some proposals put forward by other partners have been discussed and rejected as they did not represent a position that SEPD recognised or supported. These recommendations are set out in DISCERN Booklet 2 of the Final Report, which also provides references and links to the deliverables that informed the recommendations. This Booklet is available via the DISCERN website:

- DISCERN Booklet 2 - DISCERN Recommendations on Standardisation Activities

Required Modifications to the Planned Approach During the Course of the Project

The DISCERN project had been scheduled to finish in January 2016. Due to delays to one of the DSO partner's demonstration sites that related directly to preparation of the Final Report, in addition to the time required by the external print agency to managing the layout and printing of the Final Report, extensions to both the EU FP7 and NIA projects were requested and accepted. These extended the project by 3 months, such that it concluded in April 2016.

This affected the timing of the WP9 Dissemination and Exploitation of Project Results and WP10 Project Management Work Packages and the timing of the DISCERN 'Final Event' only. It did not affect overall budgets.

Lessons Learnt for Future Projects

SEPD's involvement with the European FP7 consortium through the DISCERN Knowledge Transfer NIA project has proven to be a very positive experience.

As SEPD's contribution focused on sharing knowledge from the NTVV project, participation in DISCERN has provided a valuable means of leveraging the results and experience drawn from NTVV to access a range of additional knowledge and expertise. It is also clear that there is value in sharing projects and wider innovation portfolios across national boundaries.

The processes for engaging within the project and other partners worked well, with knowledge and experience contributed by means of data provision, meetings, workshops, conference calls, structured questionnaires, interviews and reports. The SEPD NIA project team contributed information relating to technological, operational, financial and regulatory issues, drawing on experts from across the business as required.

The following sections set out ways in which direct learning from the EU FP DISCERN project in addition to knowledge and expertise accessed through the working relationships developed within DISCERN have and may be exploited in future projects.

Financial Reporting Governance

The EU FP7 financial and progress reporting obligations have detailed and specific governance processes, and are administered via the European Commission's Research & Innovation Participant Portal. For any organisation involved in an EU funded project, it is highly important to set up clear cost reporting structures at the outset of the project to capture expenditures on resource, travel, equipment, etc., against the various project Work Packages. Such reporting structures will need to ensure compliance with both EU project reporting requirements and GB or business reporting requirements, to allow the smooth administration of the project with costs apportioned correctly across categories, Work Packages and different funding streams.

Use Case & SGAM Methodologies

DISCERN has demonstrated the value of applying the Use Case & SGAM methodologies in communicating and assessing innovation projects, and these approaches merit significant consideration and application in future projects. Further, beyond communicating and disseminating innovation projects, SGAM and the Use Case methodology have a range of applications during Smart Grid project development, bringing benefits to a range of industry stakeholders. The DISCERN Use Case & SGAM tools, and the accompanying guidance material created through DISCERN, provide a useful and accessible means of engaging with and gaining experience in these approaches. These tools are freely available to all interested parties, including GB DNOs, via the DISCERN website www.discern.eu/project_output/tools.html.

Building on the experience gained through DISCERN, SEPD has become involved with the SGF's Work Stream 9 SGAM working group. Through this group the recommendation has been made to DECC & Ofgem to promote the use of SGAM across the industry - from utility companies and product vendors to policy makers and potential investors - to support delivery of efficient and interoperable Smart Grids. As two specific actions to encourage the use of SGAM, the working group has proposed that DECC & Ofgem promote the use of SGAM to share knowledge as part of the dissemination activities for innovation projects, and that SGAM coaching sessions are made available in conjunction with InnovateUK and the Energy Systems Catapult, to support people in gaining experience and familiarity with the approach, in the way that DISCERN has nurtured SEPD through this process.

Business Case Evaluation

The business case evaluation undertaken in DISCERN illustrated the issues inherent in undertaking a Cost Benefit Analysis (CBA) for innovative solutions being trialled through a project. A number of factors make research and innovation trials distinctly different to technology deployments within business as usual, such as:

- the focus on proving a technology;
- the bundling of costs for aspects of a project delivered by project partners;
- the technology readiness levels of new technologies;
- the costs of a solution under development against the costs of an established solution from a competitive market;
- the economies of scale of deployment; and
- the potential need for adjusting business processes or cultural change to transition innovative solutions into business as usual.

DISCERN demonstrated that the primary value of using a CBA approach for innovation projects is in the identification of cost drivers and establishing the sensitivity to these costs, rather than in determining specific quantitative values. Cost drivers can be used as a point of reference for moving from a trial project to a scaled, business wide deployment, and in assessing the potential for replicating a solution on a different network.

Similarly, DISCERN provided practical experience of the use of KPIs (Key Performance Indicators) to assess the performance of the solutions deployed within the project. A DISCERN KPI Questionnaire was developed for the use of project partners. This took the form of an Excel spreadsheet template, and the KPIs and calculation structures were based on the EEGI KPI Framework, with enhancements incorporated to reflect the feedback of DISCERN project partners.

This experience indicated that a set of well defined KPIs can provide a valuable means for monitoring the performance of individual projects, however the use of KPIs for comparisons between projects can be misleading due to project differences such as the issue to be addressed by the technical solution, the maturity of the devices and systems used, the specific network environment and the scale of the project. As such, it is recommended that the use of a KPI framework for comparison should be avoided. The DISCERN external KPI Workshop held in January 2016 allowed lessons to be shared with external innovation projects, including a range of other European collaborative projects, and provided a valuable forum for discussion. This event is documented on the DISCERN website www.discern.eu/events/workshopIV.html.

Scalability & Replicability Assessment

The framework created for qualitative analysis of the replicability and scalability of solutions within DISCERN is considered to be a helpful addition to methodologies that evaluate Smart Grid solutions and assist DNO/DSOs in understanding and adapting solutions for their own networks. The structured assessment based on reference lists of scalability and replicability factors helps to highlight where detailed consideration would be of value to an adopting party to ensure the feasibility of scaling or replicating the solution in a different network environment.

Similarly, the SWOT analysis which reflects the elements of a solution as represented in the different layers of SGAM may add value in the dissemination of innovation projects.

Standards to Promote Interoperability

The IOP Tool developed by the European standards organisations (CEN-CENELEC-ETSI) maps available standards to Smart Grid Use Cases, and so provides a useful point of reference for DNO/DSOs when developing systems and solutions. This provides an efficient means of identifying the standards that will allow organisations to build interoperability into both innovation and business as usual projects, supporting the efficient transition to Smart Grids.

CIM2Matpower Tool for Modelling & Simulation

As set out above, the CIM2Matpower tool created through DISCERN has been provided to the NPL together with SEPD network model CIM data available from the NTVV project, with expert guidance on its use provided to the NPL by the DISCERN project partner responsible for developing the tool. These project outputs have been shared with the NPL to contribute to their ongoing research into optimal levels of distribution grid monitoring as part of the EU funded EMRP project GridSens.

Broader Expertise & Knowledge

The working relationships formed through DISCERN have also provided access to knowledge and expertise beyond the scope of the DISCERN project.

DISCERN project partner Iberdrola have shared knowledge and experience on their use of PLC with SEPD and EATL as project partners for the I^2EV LCNF Tier 2 project. Iberdrola have also confirmed that they will be happy to support SEPD with further guidance and information in future, should further queries regarding the use of PLC arise within innovation or business activities.

Contacts with a number of project partners have also provided access to a range of reports and studies relating to the development of baselines for comparison with actual load profiles to assess the impact of demand reduction events. This has supported SEPD's development of a practicable and impartial baseline methodology that has been incorporated into the commercial arrangements for SSEPD's Constraint Managed Zones.

Note: The following sections are only required for those Projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

The DISCERN Knowledge Transfer NIA project has facilitated SEPD's participation in the EU FP7 DISCERN project, and provides access to all deliverables and tools developed across the Work Packages. This section presents these outputs.

DISCERN Final Report

The core Final Report and associated Booklets summarise the project as a whole, and act as signposts to the detailed deliverables. This material has been published in hard copy and is available electronically via the DISCERN website:

- DISCERN - Final Report - this introduces and provides an overview of the EU FP7 DISCERN project's aims and outputs
- DISCERN Booklet 1 - DISCERN Tools for Smart Grid Solution Design and Assessment - describes the set of reusable methodologies and tools developed and trialled within DISCERN that can be used by DNO/DSOs to help determine optimal levels of intelligence for their specific grids and network context with a greater level of confidence, and in supporting knowledge sharing between all relevant stakeholders
- DISCERN Booklet 2 - DISCERN Recommendations on Standardisation Activities - describes the contribution made by DISCERN to the promotion and improvement of communication standards and canonical data models that help achieve interoperability for the evolution to Smart Grids
- DISCERN Booklet 3 - DISCERN Demonstration Sites - from Design to Implementation - details the Smart Grid solutions installed during the course of the project, as designed and developed drawing on the experiences of the solutions implemented by DNO/DSO project partners at innovation project sites prior to DISCERN

DISCERN Deliverables

The DISCERN deliverables detail the project's activities, assessments, methodology development work and conclusions. These have been drawn on to create the core Final Report, and to inform the recommendations made by the DISCERN consortium to a range of stakeholders. The project deliverables are freely available via the DISCERN website www.discern.eu/project_output/deliverables.html.

A complete list of the DISCERN deliverables by Work Package is provided in Table 7 below.

Table 7 - EU FP7 DISCERN Project Deliverables by Work Package

WP1 - Architectural Options and Definitions of KPIs	
D1.1	List of Agreed KPIs with Associated Metrics and Refined Smart Grids Functionalities List
D1.2	Intermediate Demonstration Projects KPI Fulfilment Report: Definition and Calculation Methodology of DISCERN KPIs
D1.3	Architecture Template and Guidelines
D1.4	The DISCERN Method for Smart Grid Solution Design - Overview of Process and Tool Support
D1.5	KPI Fulfilment Report

WP2-3 - Distributed Devices Functionality/Communication Infrastructure	
D2.3.1	Catalogues and Requirements for Distributed Devices and Communication Architectures
D2.3.2	Tool Support for Managing Use Cases and SGAM models
D2.3.3	Standard Assessment Regarding Devices and Communication Architectures
D.2.3.4	Evolution of Learners' Solutions: from Requirements to Implementation
D2.5	Final Report on DISCERN Standardisation Activities
D3.5	IT Security Concept

WP4 - System Integration Concept/SCADA Compatibility/Other Enhancement Functions	
D4.1	Identification of Present System Architecture
D4.2	New System Functionality
D4.3	Preferable General System Architecture, Integrations and User Interface

WP5 - Operational Process Integration Concept/Technical Specifications

D5.1	Semantic Model to Transfer Developed Solutions to DSOs and to Facilitate their Integration
D5.2	DISCERN Guide for Facilitating the Replication and Scalability of the Solutions
D5.3	Technical Specifications for Implementation and Economic Analysis
D5.4	Standardisation Assessment Regarding Canonical Data Models

WP6 - Technical Evaluation and Replicability Assessment of the Solutions

D6.1	Identification of the Scenarios and Distributed Intelligence Solutions
D6.2	Simulation Test of DISCERN Solutions
D6.3	Communication Infrastructure Simulation and Assessment
D6.4	Technical Evaluation of the DISCERN Solutions Based on Simulations

WP7 - Field Tests at Existing Demonstration Sites

D7.2	Monitoring and Testing Report: The Lessons Learned from the Field Tests

WP8 - Economic Viability, Business Cases, Recommendations

D8.1	Business Case of Use Cases and Sensitivity Analysis
D8.2	SWOT - Analysis of Applied Technologies and Solutions
D8.3	DISCERN Final Recommendations

WP11 - Methodologies for Reusing and Comparing Information about Smart Grid Projects

D11.1	Functional Description of the Comprehensive Smart Grid Data Repository
D11.2	Data Management Concept for the Comprehensive Smart Grid Data Repository
D11.3	Role-based Access, Anonymisation, and Security Concepts for the Comprehensive Smart Grid Dashboard System

DISCERN Tools

As referenced under 'Objective 2' above, the suite of tools created within DISCERN to support the assessment and design of Smart Grid solutions comprise the following:

- Use Case & SGAM Tools
- Standards Assessment and proposed DISCERN IT Security Concept
- DISCERN Semantic Model
- Simulations and the Cim2Matpower Tool
- DISCERN KPI Framework
- Cost Benefit Assessment Methodology

These tools are introduced in DISCERN Booklet 1 of the Final Report, available via the DISCERN website:
- DISCERN Booklet 1 - DISCERN Tools for Smart Grid Solution Design and Assessment

Further, the Use Case & SGAM tools and templates, together with a link to the UCMR, are freely available via the DISCERN website www.discern.eu/project_output/tools.html.

DISCERN Recommendations

The core Final Report presents the specific, high level recommendations made by the DISCERN consortium as drawn from their experiences during the project. Comprehensive recommendations are provided for:

- Distribution System Operators
- Vendors and Technology Providers
- Standardisation Bodies
- The European Commission
- National Policy Makers
- Scientific Institutions and Consultants

Dissemination to Publicise these Outputs

Dissemination of the project and its findings is a requirement of both the EU FP7 and NIA funding mechanisms.

At the European project level, this has and continues to occur through conference presentations and workshops organised by project partners, as well as through publications in industry journals.

SEPD also continues its own internal and external dissemination of the project activities and recommendations through such things as presentations, newsletter articles and participation in discussions within the UK industry, such as SGF meetings and workshops.

The DISCERN core Final Report has been publicised via the SEPD Future Networks mailing list and posts on the Future Networks LinkedIn and Twitter accounts. Questions and requests for further information on the project have been invited via the Future Networks email address futurenetworks@sse.com.

Presentations relating to DISCERN are planned for the proposed SSEPD Future Networks conference, and during the 2016 LCNI Conference.

Opportunities for Future Projects

With regard to proposals for future projects, DISCERN makes two key recommendations for future work that, if taken into development, will enhance and broaden the capabilities of SGAM and bring greater benefits to industry.

A recommendation has been made to the CEN-CENELEC-ETSI SGCG to update the SGCG reports that defined the first version of SGAM to facilitate the mapping of SGAM models to reference models designed by Smart Grid cybersecurity experts, such as the NISTIR 7628 'Guidelines for Smart Grid Cyber Security'. This facility will allow those developing new systems or solutions to readily identify relevant security standards to ensure the security and integrity of the communication systems used.

DISCERN has also proposed a structured approach for using the high-level SGAM models to define the specific CIM-based interfaces needed for a solution. This SGAM-to-CIM methodology is a step-wise process for using SGAM representations of Smart Grid solutions to specify the format of the messages that will allow information to be exchanged within a solution, generated as CIM-based XML Schemas. SEPD, in keeping with the wider European project consortium, strongly see the value of this progression and would be very interested to see the DISCERN SGAM tools developed to provide automated generation of CIM message payloads.

Planned Implementation

The DISCERN project has drawn together the activities of five demonstration sites across Europe. Various monitoring and control systems were installed at innovation project sites within the DNO/DSO participant networks prior to project initiation, and further additional installations were undertaken within the scope of the EU FP7 DISCERN project. The solutions implemented have been analysed and assessed using tools and methodologies created during DISCERN.

The experience and knowledge shared during the project, as documented in the outputs delivered, provides a wealth of information on the Smart Grid functionalities implemented by DNO/DSO project partners and the factors to be considered when replicating or scaling solutions. This information on the technical solutions deployed and the communication standards and protocols used is available to GB and European DNO/DSOs as reference for the development of innovation and business as usual solutions through the published material and UCMR.

SEPD will review this material when developing future projects, and the availability of the project outputs and core Final Report has been publicised to other DSOs via SEPD's Future Networks email, LinkedIn and Twitter accounts, with further dissemination events planned as described under 'The Outcomes of the Project' above.

The tools and methodologies developed and trialled within DISCERN each present potential options for consideration when disseminating innovation project activities and when developing new projects. The implementation plans for the different approaches applied within DISCERN are set out in the following sections.

Use Case & SGAM Methodologies and Tools

DISCERN has demonstrated a range of benefits associated with using SGAM and the Use Case methodology to communicate innovation projects and when developing, designing and procuring solutions. To build knowledge of SGAM within the business, the DISCERN tools and methodology have been shared with a number of colleagues beyond the DISCERN project team, and this engagement and dissemination will continue beyond completion of DISCERN.

SSEPD has used SGAM as part of the OJEU procurement process for introduction of its CMZ schemes.

Following this, SEPD are also developing plans to use SGAM within a number of other innovation projects. As two examples, the Low Energy Automated Networks (LEAN) LCNF Tier 2 project plans to use SGAM to develop the system architecture for trial of the LEAN technology on the SEPD network, and the proposed ReZone project plans to use SGAM to describe the operational and commercial model aspects of the project in the ReZone bid document.

SEPD are also looking to represent a number of other innovation projects using SGAM to draw on its value in communicating such projects to other DNOs, allowing them to understand what's been implemented for a project and to evaluate the adaptations necessary to replicate a solution with their own systems.

Further, the benefits demonstrated through DISCERN have led to SEPD presenting on various themes relating to SGAM at a number of SGF meetings and workshops, and becoming involved in the SGF's Work Stream 9 SGAM working group to demonstrate the value of SGAM and promote its use within Great Britain.

CIM

Knowledge and material relating to the application of a CIM semantic model has been shared with colleagues from different areas of the business (including Innovation, ICT and the Data Architects for a new Work & Asset Management project) to promote awareness and understanding of the potential value and benefits of CIM. Discussions over the use of CIM in both innovation projects and business as usual application are ongoing beyond the completion of DISCERN.

Scalability & Replicability Assessment

The framework created for qualitative analysis of the replicability and scalability of solutions within DISCERN provides a structured approach for highlighting areas where detailed consideration would be of value to a DNO/DSO when evaluating the feasibility of scaling or replicating a Smart Grid solution in a different network environment. The assessment factors reflect circumstances, characteristics or considerations that will have an influence on the replicability or scalability of a solution.

This approach is shaping the business's thinking with regard to aspects to be incorporated into deliverables prepared for projects such as NTVV.

Similarly, the use of a SWOT analysis reflecting the different layers of SGAM may add value in the dissemination of innovation projects. SEPD will look to use this approach in dissemination activities where appropriate to identify the advantages and disadvantages of using the components and communications systems trialled within the business's innovation activities such that these can be understood and managed, supporting the appraisal of alternative architectures to suit differing networks and operational structures.

Standards to Promote Interoperability

The European IOP Tool has been shared with NTVV project partner EATL to inform their work on reviewing the standards of relevance for LV monitoring.

Additionally, this tool provides a useful point of reference for future innovation and business projects to identify standards that will support interoperability within systems developed.

CIM2Matpower

The CIM2Matpower tool has been shared with the NPL together with SEPD network model CIM data and LV monitoring data available from the NTVV project. These project outputs have been shared with the NPL to contribute to their research into optimal levels of distribution grid monitoring as part of the EU funded EMRP project GridSens.

PLC

Information detailing the use of PLC within the DISCERN European partners' demonstration sites has been shared with colleagues from the Innovation team for consideration with regard to future project development.

During the course of DISCERN, European project partner Iberdrola also made their PLC experts available to discuss the use of PLC technology with SEPD their I^2EV LCNF Tier 2 project partner EATL, and advise as to what investigations could be done to understand and resolve the technical issues experienced within that project. SEPD have been invited to draw on the expertise of Iberdrola should future queries regarding the use of PLC arise within innovation or business activities.

CMZ Demand Reduction Baseline Methodology

The information and research regarding the benefits and constraints of applying different baseline methodologies to assess the impact of demand reduction events has informed the development of a practicable and impartial methodology as applied for SSEPD's introduction of CMZs.

Other Comments

The original project budget for the NIA DISCERN Knowledge Transfer project was £249,107. This figure represented around 45% of the total NIA and EU FP7 DISCERN project budget for SEPD as the 'Research and Technological Development' and 'Demonstration' Work Packages were 50% funded through the EC FP7, and the 'Other Specific Activities' and 'Management of the Consortium' category Work Packages were funded in their entirety through the EU FP7.

The final figure for IFI/NIA funding over the course of the project is around £70,500 (again accounting for exchange rates), representing around a third of the original IFI/NIA budget. Similarly, the funding required from the EU FP7 was approximately a third of the original budget, at around £93,000.

A number of factors have contributed to this variance, as follows:

- the hourly rates originally used to construct the forecasts provided to the lead European project partner for budget setting purposes included an element of overheads, however the EU financial reporting governance required direct staff costs to be reported with overheads accounted for using the Indirect Cost Model specified within the EC Financial Reporting Guidelines, as such the figures derived erroneously included an extra element of overheads, whereas the annual financial reporting figures recorded the direct staff costs excluding overheads, in accordance with project governance;
- through SEPD's recruitment of a dedicated DISCERN Project Officer to manage the company's participation in DISCERN less involvement of senior management has been required on an ongoing basis, as such the direct staff costs reported for the project have reflected lower hourly rates;
- efficient working practices have ensured that SEPD have contributed fully to DISCERN and met all project requirements and requests well, however with less resources than planned - when comparing the hours allocated for the different Work Packages during project planning (as distinct from the financial budgets), SEPD have complete participation in the project within 60% of its allocated 5000 hours;
- similarly, travel requirements have been minimised by making effective use of remote forms of communication such as conference calls and web conferences.