Optique

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Deliverable D11.2

Market Analysis

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SEVENTH FRAMEWORK PROGRAMME

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Executive Summary

This document summarizes the first version of deliverable D11.2 "Market Analysis" of project FP7-318338 (Optique), an Integrated Project supported by the 7th Framework Programme of the EC. Full information on this project, including the contents of this deliverable, is available online at http://www.optique-project.eu/.

The document presents a preliminary market analysis for Optique, starting with the identification of stakeholders in a wider context, and comparing Optique features against competing solutions in the Big Data landscape. Draft value propositions for potential adopters are formulated, and primary barriers to adoption are described from an organizational maturity perspective. A methodology for risk analysis for Optique adoption is provided. Together these pieces form the necessary, basic input for developing business plans and implementation guides for Optique in subsequent project phases.

This deliverable succeeds deliverable D11.1 "Optique Initial Exploitation Report", and precedes deliverable D11.3 "Business Plan and Implementation Guide". The objectives served by this deliverable are:

- **O11.1:** Deliver a business implementation strategy, supported by an assessment model and practical guidelines to adopting Optique in the enterprise.
- **O11.2:** Deliver a software exploitation strategy, for the benefit of the partners and the European ICT industry, while protecting intellectual property created by the project.

Further work on the market analysis will be carried out in Year 3 of the Optique project, as part of the deliverable D11.3 "Business Plan and Implementation Guide".

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Contents

1 Introduction

A brief outlook on the market targeted by Optique was presented in deliverable D11.1 *"Optique Initial Exploitation Plan"*. This report presents the results of the first iteration on a more detailed market analysis. The goal of this analysis is to identify the market context, contribution and competitive position of Optique, serving as key inputs for future dissemination and commercialization activities, i.e. work to be addressed in deliverable D11.3 *"Business Plan and Implementation Guide"*.

1.1 Current Scope

In the first iteration, emphasis has been put on evaluating Optique from a business point-of-view, complementing the strategic and business impact vision and impact generation strategy for Optique (described in Technical Annex, Part B3).

The first step in this evaluation has been to perform an identification of categories of stakeholders, spanning beyond the list of actors included in the notion of *Optique ecosystem* (described in Technical Annex, Part B3). The goals and incentives related to Optique adoption are analyzed for each of the identified stakeholder categories and recommendations for suitable communication channels are made. The stakeholder analysis is used both as the starting point and for demarcation of the market analysis' scope.

The second step has been to identify the technical contribution and uniqueness of Optique in order to position Optique in the space of Big Data and data integration solutions. This is done in the form of a gap-analysis comparing features of Optique against current paradigms and approaches to data access and data exploitation.

Thirdly, the value and benefits that Optique aims to deliver to adopting enterprises are described as problem-solution statements (value propositions), and exemplified through sample industrial use cases.

Fourthly, to understand the inertia and barriers that organizations may face with respect to adoption of a new paradigm for data retrieval and exploitation, a high-level model for organizational maturity has been created. Potential barriers to adoption are classified according to parameters of the organizational maturity model.

Finally (for this iteration) a method for risk analysis of Optique implementation in an adopting organization is provided. Development of the actual risk analysis is deferred until experiences from the Optique alpha package distribution and other dissemination activities are collected.

1.2 Next Steps

The market analysis should be updated and extended as part of the work on D11.3 "Business Plan and Implementation Guide" (extending the original scope of D11.3). The continuation should focus on developing and refining the following aspects:

- Re-validate current content and update as necessary.

- Refine characteristics assessed for parameters of organizational maturity (Chapter 5, Barriers to Adoption).

- Risk Analysis (Chapter 6): Develop a generic risk analysis for Optique implementation by an enterprise. Utilize feedback, experience and lessons learnt from the Optique alpha package distribution and other dissemination activities of WP10.

- Assess selected target companies for their level of readiness to successfully adopt Optique. Use the organizational maturity concept and parameters (Chapter 5) and the stakeholder analysis (Chapter 2) as basis for this assessment. Include additional criteria as necessary. Use this assessment as foundation for estimating market size and potential.

Once the above activities have been completed, work on Optique business plans and implementation guides (original scope of D11.3) can be started. Using results from the above, one of the first steps towards a generic business plan would be to develop scenarios for overall costs and benefits of implementing Optique, for each of the end-user categories in the stakeholder analysis. (Estimates from Technical Annex, Part B3 could be used if relevant and a specific survey could identify implementation, maintenance and expansion costs for competing paradigms, e.g. traditional Data Warehouse and Business Intelligence solutions).

2 Stakeholder Analysis

The stakeholder analysis identifies customers, groups, and institutions that have an interest in the results of Optique, both as commercial solutions and as an open-source platform. A clear overview of stakeholders and their goals, interest and influence is an important precondition for analyzing the context and market for Optique, for formulating value propositions and identifying optimal communication channels. The stakeholder analysis also provides valuable input for developing dissemination material tailored for the different groups.

The identified stakeholder groups have been classified into three types to better distinguish their incentives and interest in Optique.

Type of stakeholder	Description
Potential adopter / End user	End user of Optique technology and tools.
Significant Promoter	Promoter and/or significant supporter of Optique Technology. Has considerable influence towards other stakeholders.
Interested Party	Interested in following Optique and further developments (typically a provider/vendor of competing and/or adjacent solutions).

Table 1: Stakeholder types

For each stakeholder group identified, segmentation into sub-groups is done according to the characteristics deemed most relevant for that group, e.g. for enterprises, organizational maturity is chosen as differentiating parameter while for governments, differentiation is made based on the level of fragmentation of government.

The concept of organizational maturity is important for approaching different end-user enterprises with suitable value propositions. Organizational maturity, its parameters and determining characteristics are defined in Chapter 5, where the concept is used as a basis for identification of barriers (sources of inertia) towards adopting Optique.

The stakeholder groups and their goals, incentives and interest are presented in section 2.1. The relative interest and influence of stakeholder groups is described in section 2.2, and the recommended communication channels for each group are presented in section 2.3.

2.1 Goals, Incentives and Interest

The table below shows the stakeholder groups, their classification into stakeholder type and typical goals for such a company.

Stakeholder Group	Sub-group	Type	Example Organizations	Main Goals (Incentives / Interest in Optique)
Enterprises (End-User Organizations)	Organizational Maturity: Sophisticated	Potential Adopter / End User	Lufthansa, Santander	Further value extraction from big data. Enabling data-driven performance improvements and innovation. Empowering end-users to create new knowledge. Faster access to distributed data, including streaming data sources. Lower dependency on scarce data scientists and IT experts.
Enterprises (End-User Organizations)	Organizational Maturity: Transitional Stage	Potential Adopter / End User	Norwegian Tax Administration, DNV GL, Statoil, Siemens	Address the ever increasing need of integrating disparate data sources, by moving query capabilities from IT to end-users. Information sharing across business units, sites, etc., i.e. break information barriers between silos. Master data management using ontologies (requiring less maintenance than traditional methods) More flexible and open extension of IT infrastructure for BI and data governance. Savings in time & money
Enterprises (End-User Organizations)	Organizational Maturity: Undisciplined	Potential Adopter / End User	*(Small and Medium Enterprises with low ICT and/or Data Governance competence)*	Grow business by exploiting available data, e.g. by combining different types of data to create meaningful information about customers. Transition to data-driven decision-making. Time and cost savings.
ICT Technology and Service Providers	System integrators and vendors of non-competing or adjacent solutions and systems	Potential Adopter / End User	Oracle, IBM, SAS, SAP, fluid Operations	Adoption of Optique tools and modules in own products and/or solutions, i.e. use Optique as base for proprietary solutions offered to customers.

Stakeholder Group	Sub-group	Type	Example Organizations	Main Goals (Incentives / Interest in Optique)
ICT Technology and Service Providers	IT consulting companies	Significant Promoter	Cap Gemini, Steria	Can leverage Optique for "fast-tracking" a client organizations infrastructure for business intelligence / analytics. Can deliver implementation services to enterprises wanting to use Optique.
ICT Technology and Service Providers	Competitors. *(Vendors of competing / substitute technology and solutions, e.g. Data warehouse, Business Intelligence, Ad-hoc query solutions, stand-alone analytics suites)*	Interested Party	Google (Hadoop, Spanner), Cloudera (Impala), Alteryx, Tableau, IBM (Cognos), ...	View Optique as potential threat to demand and business case for own products / solutions. Monitoring Optique progress and evolutions. Potentially interested in harming reputation and/or partners' confidence in Optique.
Standardization Organizations	N/A	Interested Party	ISO, W3C, DNV GL	Standardization of technology, methodology, languages, ontologies, protocols
Academic Institutions	N/A	Significant Promoter	*(Optique academic partners)*	State-of-the-art research (contribution and involvement, master / PhD thesis), Use of technology and tools in coursework, Open-source code-base, Basis for rapid development of new features
Independent Research Organizations	N/A	Interested Party	SINTEF, IRISA, Gartner	State-of-the-art research involvement, Benchmarking/comparison of technologies, Publish best-practice guidelines
European Union	N/A	Significant Promoter	N/A	Economic: Increased employment. Competitiveness vs USA/Asia. Political: Make Europe Big Data Ready. Position EU as competence leader within data management. Societal: increase efficiency in data use/data sharing-> delivery og social services & shared public services across borders (Police, intelligence, border control, customs)

Stakeholder Group	Sub-group	Type	Example Organizations	Main Goals (Incentives / Interest in Optique)
EU Member Country	Low Fragmentation	Potential Adopter / End User	Norway	Societal: increase efficiency in data use/data sharing-> delivery og social services & shared public services across borders (Police, intelligence, border control, customs)
EU Member Country	High Fragmentation	Potential Adopter / End User	Greece	Societal: use/data sharing-> delivery og social services & shared public services across borders (Police, intelligence, border control, customs)
Multi-Government Partnerships / Coalitions	N/A	Significant Promoter	OGP (Open Government Partnership), WEF (World Economic Forum)	Global / regional prosperity, increased responsiveness of governments, economic growth, …
NGOs	N/A	Potential Adopter / End User	Red Cross, UNICEF, EuroHealthNet, Eurochild, WWF, Amnesty International	Optique as key enabling component for implementing low-cost, easily scalable infrastructure supporting shift towards data-driven decision making in planning and operations of NGOs activities, as well as information-sharing between NGOs (e.g. development of shared regional or global emergency-response databases)
Open Source Communities	N/A	Significant Promoter	TOPCASED, OnTop	Open source platform for on-demand integration of structured, but disparate data sources. Basis for rapid development of new, open source solutions for data access and business intelligence in the Big Data Landscape.

Table 2: Stakeholder groups and goals

2.2 Relative Interest and Influence

The relative interest and influence of identified stakeholder groups is visualized in Figure 1 below. Qualitative assessment of the relative power/influence and incentive/interest enables identification of key stakeholder groups (upper right quadrant in Figure 1). As stakeholder groups of all three types (potential adopter, significant contributor and interested party) end up in the "Key Stakeholder" quadrant, a broad range of communication channels need to be considered.

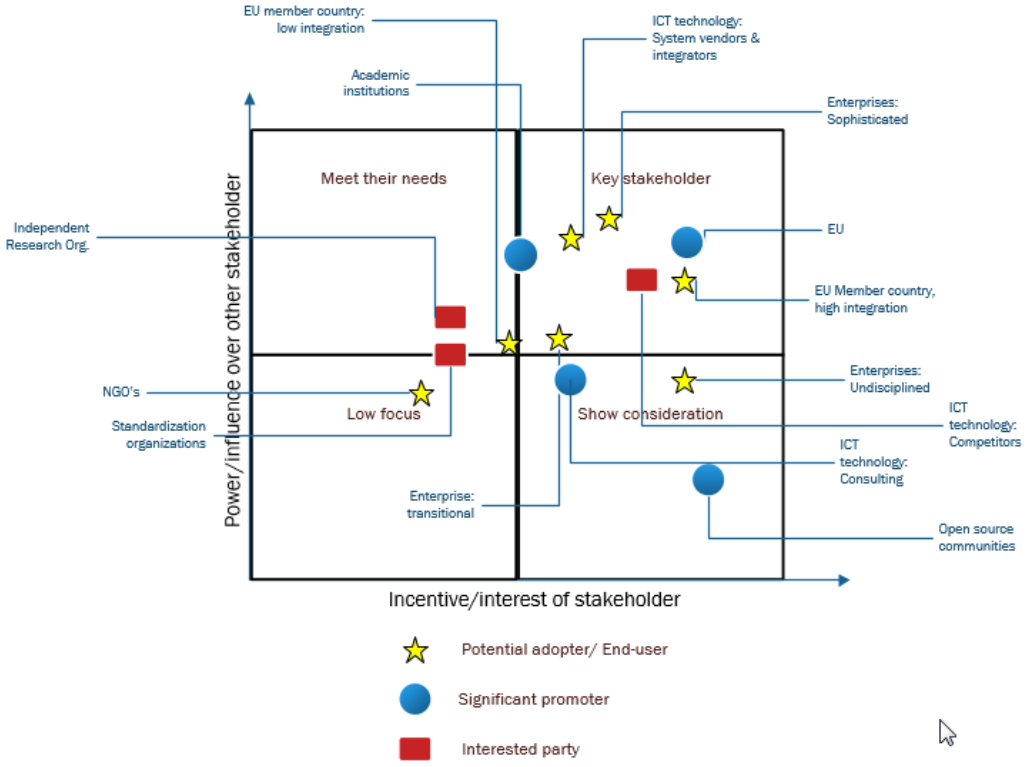


Figure 1: Relative interest and influence of identified stakeholder groups

2.3 Recommended Communication Channels

The Optique Partner Program is an important part of the overall communication and dissemination strategy of Optique, and provides a context for interacting with key stakeholders. Effective dissemination and stakeholder communication is however dependent on selecting the appropriate communication channels. The most relevant communication channels for each stakeholder group are presented in Table 3 (next page). The Optique Partner Program is described in Appendix 3: The Optique Partner Program

Stakeholder Group	Type	Communication Channels					
		Partner Program	C-level briefs, whitepapers, videos, webinars	Academic journals, research publications	Industry seminars and conferences	Public showcase (with open data)	Training courses
ICT Technology : Consulting	Significant Promoter				x	x	x
Academic Institutions	Significant Promoter		x	x	x	x	
European Union	Significant Promoter	x	x				
Multi-Government Partnerships / Coalitions	Significant Promoter		x	x			
Open Source Communities	Significant Promoter	x	x		x	x	
Enterprises: Sophisticated	Potential Adopter / End User	x	x	x	x	x	x
Enterprises: Transitional Stage	Potential Adopter / End User	x	x			x	x
Enterprises: Undisciplined	Potential Adopter / End User	x	x		x	x	x
ICT Technology : System integrators and vendors	Potential Adopter / End User	x	x	x	x	x	x
EU Member Country: High Integration	Potential Adopter / End User		x	x		x	
EU Member Country: Low integration	Potential Adopter / End User		x			x	
NGOs	Potential Adopter / End User		x			x	x
ICT Technology: Competitors	Interested Party		x			x	
Standardization Organizations	Interested Party		x	x		x	
Independent Research Organizations	Interested Party		x	x		x	

Table 3: Recommended communication channels

3 Gap Analysis

The focus on the gap analysis is to evaluate the Optique solutions' main features' and characteristics as a commercially available solution (to address big data challenges). A gap analysis must be done against a baseline. The key trends & drivers (chapter 3.1) identifies major trends within the realm of Optique: Big data and data integration.

Four different approaches to the Big Data and Data integration challenge and as such competitive solutions are detailed in chapter 3.2. The analysis is a qualitative rather than quantitative assessment of competing solutions to be able to identify both the benefits and (potential) shortcomings of the Optique solution.

3.1 Key Trends and Drivers

Big data

Increased connectivity, new capabilities for capturing, storing, processing, presenting, and visualizing data, and in particular large volumes of varied data at high velocity, has developed significantly the past few years. Big Data solutions aim to effectively aid decision – making, allowing users to work more effectively by focusing on accurate information and how to use it when required. The market is showing increasing signs of maturity where big data becomes part of overall information infrastructure, needing master data management, data integration, security and so forth. The question posed by more sophisticated enterprises is moving from "what is big data and how can I use it?" to "how can I get value from big data". A range of advanced tools have come to the market to help for instance oil and gas operators make sense of this so-called 'Big Data', in order to understand how to bolster performance across thousands of wells and, in real-time, monitor the condition of advanced equipment.

But the technical limitations of today's computing systems are already struggling to manage the amount of information that some operators are required to handle, sparking a search for smarter ways in which data could, and should, be analyzed.

Data integration

The discipline of data integration comprises the practices, architectural techniques and tools for achieving consistent access to, and delivery of, data across the spectrum of data subject areas and data structure types in the enterprise.

Data integration is at the heart of modern information infrastructure. Companies continue to seek a full range of capabilities to address diverse use cases which often include business intelligence (BI) and analytics.

More organizations are selecting data integration tools that provide tight links to data quality tools to support critical initiatives. There is an increasing demand for data to be delivered or processed in real time (or near real time) to match the speed of a business. The data warehouse (DW) must manage a range of data latencies to make data available for use within acceptable service levels.

> Support for big data issues ranks only No. 16 in the list of factors that buyers consider when selecting a data integration technology and vendor. Buyers place most importance on functional capabilities, followed by performance, scalability and the vendor's overall expertise.
> Buyers even rank the fact that they already use other products from the vendor as slightly more important than support for big data when evaluating products and vendors
>
> Source: Gartner Inc, The state of Data integration: Current Practices and Evolving trends (April 2014)

Many companies still consider open source programs immature, but more and more information management leaders recognize that the functionality of open-source data integration tools is becoming more refined through increasing adoption.
Uptake will continue to rise — particularly for well-scoped, often small-scale deployments and data migration — as deployment of open-source software for other infrastructure areas (such as operating systems and DBMSs) grows .

3.2 Competing Solutions

The below solutions address to a varying degree the key trends identified, but are well-established in the market as approaches and technologies to meet the Big data/ Data integration challenge.

3.2.1 Data Warehouse

A data warehouse solution integrates data from one or more disparate sources creates a central repository of data, a data warehouse (DW). Data warehouses store current and historical data by uploading from different sources to be used for reporting purposes.
The DBMS market grew by 9.4% in 2013, to $28.7 billion, with a majority of the growth driven by data warehousing. Organizations will continue to modernize existing data warehouse (DW) infrastructure as big data and mixed workload becomes more complex, as integrating big data becomes a requirement, and as cost-benefit considerations become a decision factor when persisting data. DW architectures now includes data federation, distributed processing across clusters and in-memory DBMSs— the logical DW.
Although traditional DW requirements continue to drive most of the market, the DW DBMS market continues to be disrupted by new approaches and, as a result, customers are hesitating when it comes to choosing a DW strategy[1].

3.2.2 Business Intelligence

Business intelligence (BI) is the set of techniques and tools for the transformation of raw data into meaningful and useful information for business analysis purposes. Often BI applications use data gathered from a data warehouse.

1 Gartner, Inc. | The State of Data Warehousing in 2014, June 2014

3.2.3 Ad-Hoc Query and Reporting Solutions

The ad hoc Query approach is commonly used to meet a need for answering "one-off" questions that are not easily extracted /not included in existing reports. An IT expert will be able to connect or manipulate direct connections between databases (e.g. with SQL queries or the like) to give an answer to that particular question with less effort that re-defining the report for such ad-hoc queries; In addition, MS excel exports and manipulations are often used for the same purpose.

3.2.4 Stand-Alone Data Analytics / Visualization Tools *(e.g. Excel-input-based tools)*

Data analytics is the process of examining raw data with the purpose of drawing conclusions about that information Data analytics focuses on inference, the process of deriving a conclusion based solely on what is already known by the researcher
Such solutions can often be purchased to solve a specific scope, not necessarily in conjunction with a "big data" initiative or a data warehouse. In general, big data functionality is more and more decoupled from dedicated data storage technologies. Graph analytics will move beyond graph databases; in-memory analytics will separate from specialist in-memory databases.

3.3 Feature Comparison

A high-level comparison of Optique against the competing solutions described in section 3.2 has been carried out. The comparison evaluates how features related to finding data, exploring data and exploiting data are realized by Optique and the competing paradigms. The comparison is documented in Appendix 1: Feature Comparison.

4 Value Proposition

This chapter identifies the value and benefits that Optique aims to deliver to adopters (end-users). Understanding what disruptive benefits Optique has to offer, and what business problems Optique addresses, is a key input to producing business plans and enterprise implementation guides for Optique.

4.1 Value and Benefits to End-Users

The below table describes seven generic problems from a business perspective that enterprises are struggling with today or are likely to experience as they evolve. For each generic problem, the solution offered by Optique is described (using non-technical language).

#	Problem	Solution offered by Optique
VP1	Enterprises have large amounts of high-quality data available in disparate data sources, but end-users cannot access this data without extensive support of intermediaries e.g. IT experts.	Optique closes the gap between end-users and data by enabling flexible, ontology-based queries (i.e. queries in a language familiar to the end-user). Optique leverages semantic technologies to enable on-demand integration of data from disparate sources independent of database structures.
VP2	Value extraction from data in an enterprise is often constrained by pre-defined data mappings and limitations of the organization's infrastructure.	Optique leverages semantic technologies to enable on-demand integration of data from disparate sources independent of database structures. Optique enables enterprises to explore and discover new relations between data from different sources, and continuously expand data platforms in a cost-efficient manner.
VP3	Enterprises have to undertake large efforts and investments to extend their data platforms and integrate new data sources.	The flexibility offered by semantic technologies allows enterprises using Optique to easily scale their data platforms, rapidly deploy and evolve business models with high data dependencies, and avoid costly vendor lock-ins.
VP4	Turnaround times for traditional methods of accessing large volumes of data constrain time-windows for decision-making and lead to suboptimal decisions.	Optique reduces the turnaround time for data access by closing the gap between end-users and data sources, eliminating the need for IT experts and proprietary languages and technology in the query process.

#	Problem	Solution offered by Optique
VP5	As volumes increase and data is harvested from multiple, unrelated sources, end-users of the data have low transparency to the origin, integrity and trustworthiness of the data.	Optique provides increased transparency between data and the end-users, informing the end-user about the origin of data and all transformations it has undergone, by tracking the data's provenance.
VP6	In many environments, the exponentially growing volumes of data generated by sensors and other MEMS[2] units is currently underutilized as a source of valuable information, often due to complexities such as the need for non-trivial correlation of real-time, streaming data with static data from other sources.	Optique equips experts with the ability to perform "continuous queries" on large-scale data streams received from multiple sources in parallel, and combine traditional data querying techniques with statistical methods for trend analysis. This enables data-driven business process automation, e.g. predictive diagnostics and automated dispatch of servicing.
VP7	With increased digitalization of business processes, IT infrastructure is becoming a bigger source of risk and enterprises are adopting more flexible and scalable infrastructure solutions leveraging virtualization and cloud computing.	Optique supports elastic computing schemes for distributed query planning and execution, allowing a more optimal utilization of available computing resources. This results in better trade-off between completion-time for queries and the cost of resource usage.

[2] Micro-electro-mechanical system

Any enterprise adopting Optique as part of its overall strategy will reap the value and benefits offered by Optique over time. Some benefits will be immediate quick-wins. Other benefits will be intermediary and long-term, transformational results.

Benefits		
Immediate	**Intermediary**	**Transformational**

Immediate benefits can quite easily be adopted by all types of enterprises and stakeholders without too much additional time and efforts spent.
 	
Examples:
• reduced time in accessing information
• reduced IT cost
• new ways of using IT staff
• more timely decisions
• decisions based on more facts
• able to make more and precise
• decisions
• improved maintenance schemes
• less shutdowns
  • reduced cost in spare parts
  • optimized utilization of costly equipment
  • more successful business decisions / hit rates
  • provenance/trustworthiness
  • compliance
	These benefits will require some additional levels of insight and maturity to be adopted. New information and new insights in own business will create opportunities that require some maturity to harvest.
	
	Examples:
	• increased knowledge
	• enhanced business
	• improved information quality
	• increased information value
	• collaboration between disciplines
	• improved management of performance and risk
	• information transformations
	• more efficient work processes
	• increased connectivity
	• better/new insight in own business
	• big data analytics
	• increased use of sensor data
	• predictive maintenance
	• better information for narrower decision windows
	• real-time monitoring
	• forecasting of events
	• optimization of asset utilization
		To adopt transformational benefits the enterprise needs to contain high level maturity and insight in own business and information resources. Benefits in this area require high level agility, innovation and ability to change and implement new business models.
		
		Examples:
		• new knowledge
		• business improvements
		• new business deliveries
		• business transformations
		• industrial internet / internet of things
		• targeted marketing and sales
		• health diagnostics and targeted treatment
		• more knowledge about complex equipment / systems
		• intelligent operations
		• process and value chain optimization

Table 4: Benefits of adopting Optique in short, intermediary and long term

4.2 Sample Industrial Use Cases

As a guide to current research and technology development in Optique, three industrial use cases from the Oil & Gas and Energy industries have been developed through the Optique partner program. These use cases can be used for further understanding of the benefits offered by Optique

and serve as input to creating business and implementation plans. The three use cases are presented in Appendix A.

4.2.1 The Statoil Use Case

The exploration department of oil and gas company Statoil has to find new hydrocarbon reserves in a cost effective way. Ultimately, the only way to prove the presence of a reserve is to drill an exploration well. But since drilling is very expensive, it is important to maximize the chances of success.

To do this, all available data from previous and ongoing exploration and production projects is used to extrapolate a model of the geology of a field. This allows anticipating the presence of hydrocarbon reserves.

Stratigraphy, or the study of rock layers and layering, is an important reference framework used in this work. Several types of stratigraphy are being used. Two are specifically important:

- Chrono-stratigraphy: based on the absolute age of a certain rock, and making it possible to reconstruct the geology for a certain moment in the past. Chrono-stratigraphy is standardized internationally.
- Litho-stratigraphy: based on the study of a given specific type of rock that may have been deposited during a period of time. Litho-stratigraphy may vary by sedimentary basin or even from field to field.

Both frameworks can be useful in different context, and sometimes it is required to be able to combine information obtained from data that is described in one or the other.

The data used in exploration at Statoil is primarily found in the historical corporate database, the Exploration & Production Data Store (EPDS). It may also be retrieved from databases that belong to ongoing exploration and development projects, the project databases. These are large and richly structured data stores. The typical work is that exploration experts like geologists, paleontologists, etc. have to extract tables, called snapshots from these large corporate databases, which are then post-processed and fed into visual analytics tools, primarily ArcGIS (by Esri).

Simple “standard” snapshots can easily be produced by the domain experts themselves using existing tool support. But in most cases however often – and this is the case covered by Optique – the help of an IT expert is required to extract snapshots containing more specialized information, process which is perceived as time consuming and not very efficient.

Optique will support the formulation and executive execution of queries over data from completed projects, stored in the Exploration & Production Data Store (EPDS), a single, richly structured relational database comprising thousands of tables and thousands of attributes, see below.

The aim is to include the data from running projects into the scope of queries. This data not yet integrated in to EPDS, but spread over several in-house “project databases.” These databases have a different, though related structure to EPDS, so query execution will exercise both Optique’s federation and data integration capabilities.

Including project databases in query execution may imply that up to 100TB of data must be processed within the scope of a single query. Data integration challenges, technological barriers of query federation, and the sheer volume of data make the use of project databases practically impossible with today's existing tools.

4.2.2 The Siemens Use Case

Siemens Energy Services is the leading service partner for an installed fleet of power plants representing approximately one-fifth of all large scale and industrial power plants worldwide. Siemens runs several service centers for power plants, each responsible for remote monitoring and diagnostics of many thousands of gas/stream turbines and associated components such as generator and compressors. Diagnosis engineers working at the service centers are informed about any problem detected on site and plan and initiate necessary maintenance activities.

A Siemens engineer access a variety of raw and processed data in order to isolate a problem and to plan appropriate maintenance activities. Fault analysis and maintenance planning is conducted using a variety of tools ranging from MS Excel spreadsheets to highly specialized in-house visualization, diagnosis and planning tools. These tools have to work on several TB of time-stamped sensor data and several GB of pre-processed "event" data ("alarm triggered at time T"). Sensor and event data may grow at 30GB per day (sensor data rate 1 Hz – 1 kHz). The required data is spread over hundreds of tables with identical, very simple structure for sensor readings and several tables with different, very complex structure for event data. Typical queries involve gathering information from a multitude of storage sites.

Currently, feeding data from the sensor and event database into the visualization and interpretation tools constitutes a complex manual process (illustrated in fig.1). If an error report is generated by a service center (dashed line), the diagnosis engineer issues a sequence of separate queries to different data sources in order to provide relevant data for visualization and diagnosis tools (called interpretation tools in Fig.1). Hereby, results of single queries are possibly combined using procedural programs. The processed query results are then supplied to the interpretation tools in order to access and visualize appliance data. For diagnosis situation not initially anticipated, new queries are required, and an IT expert familiar with both the power plant system and the data sources in question has to be involved in formulating the queries using an IDE (fig.1.), taking into account the rather complicated database schemata. Due to necessary low-level data encoding which is reflected in complex queries, the IT expert extensively tests and debugs the new queries before making them available in the service dashboard for diagnosis engineers. Thus, unforeseen situations may lead to significant delays of up to several hours or even days.

By utilizing the Optique platform Siemens Energy Services aims at improving the data access for its diagnostics engineers and thereby at more effective service operations. Effective service operations are fundamental in a market being driven primarily by an aging power plant fleet and the rising demand for increasing the efficiency of existing plants.

4.2.3 The DNV GL Use case (OREDA)

OREDA is both a joint industry project and a database with reliability and maintenance data for exploration and production equipment from a wide variety of geographic areas, installations, equipment types and operating conditions. Both offshore subsea and topside and onshore equipment are included. A number of major international Oil & Gas enterprises are participating in the project. Data has been collected since 1983 and has resulted in a large database comprising data from 265 installations and 16.000 equipment units. Some of the data collected and stored are operating and environmental conditions, all failure events related to the equipment and all maintenance records containing data on corrective maintenance linked to the corresponding failure record, and data on preventive maintenance linked to the corresponding inventory record.

OREDA has been selected to be a test case for OPTIQUE and a first implementation is currently being prepared. The intention is to investigate both technical challenges and user experiences with using Optique. Future combined use of Optique and OREDA may include the possibility to combine information from several databases into queries that so far not has been easy to perform. For example by comparing the effect of environmental factors as weather condition over a period of time with the failure rate for a specific type of equipment, can give decision support and cost savings when planning procurement of expensive process equipment.

4.2.4 The DNV GL Use case (Condition Monitoring of Ships)

Condition monitoring of machinery has a lot of similar challenges independent of branch. The challenges identified for monitoring of e.g. propulsion systems on ships in operation have a lot of similarities with the challenges described for the Siemens use case. Identical challenges have also been identified by Norwegian railroad (NSB) who has been invited to the Optique Partner Program.

The Compass project is a joint project between DNV GL, Rolls Royce and Farstad, and is sponsored by the Norwegian Research Council. The project is carried out to demonstrate the benefits of collecting machinery and operational data from ships in operation for local and remote processing. The data is transmitted to shore via satellite or manually for remote monitoring and assistance.

Diagnostics and prognostic methods can be developed that operates on the collected data or in real time. The prognosis for cost savings is considerable.

5 Barriers to Adoption

In the context of this report, barriers to adoption signify any restriction for an organizational implementation and use of a technology and the consequent relative inability to prove its value during its lifetime.

Any barrier, perceived or real, to start using a solution will have impact on the perceived risk of engaging with the product and the expected value of the product for the company/organization in question.

We believe that barriers to adoption will vary the most according to companies' maturity with regards to technology and IT. We have created a "High level Organizational Maturity model" for data integration/big data to address these aspects.

Organizational maturity is defined as a function of the following parameters, which are further described in Table 5.

- Business Model and Process Maturity
- IT Infrastructure Readiness
- Data Integration Readiness
- Data Governance Maturity
- People (Resources, Competence & Management)

The three identified sub-categories of enterprises/end-users in the Stakeholder analysis are based on the hypothesis that the incentives to adopt a solution like Optique are largely dependent on the maturity of the company. Organizations that are early adopters of technology will normally be found in all three categories of maturity, but will typically exhibit similar patterns such as being data driven and agile when it comes to moving in the market and assessing new technology.

The different sub- categories of enterprises/end-users are described by typical traits and goals in the section below.

5.1 Organizational Maturity Model

Organizational Maturity: Sophisticated

At this level, the organization perceives information quality and the ability to exchange information across systems without meticulous integrations as necessary for improved business performance. Initiatives are coordinated, but not necessarily strategic. IT departments are hard-pressed on providing queries to discipline experts. Top management committed to be data driven; creating structures, processes and incentives to support this. There is still room for improvement, but the organization strives to meet change and remain agile.

Typical goals for a company at this level:

- Further value extraction from big data (using analytics on current data)
- Enabling data-driven performance improvements and innovation.

- Empowering end-users to create new knowledge.
- Faster access to distributed data, including streaming data sources.
- Lower dependency on scarce data scientists and IT experts

Organizational Maturity: Transitional Stage

At this level, the organizations business and IT leaders Management recognizes the need for information sharing between disciplines and has fragmented initiatives across some systems, and information slowly is becoming an asset rather than a liability (moving away from lack of trust in data or inability to find data). General IT governance guidelines and policies are formalized. The IT department has strong "traditional" experts that are overworked.

Typical goals for a company at this level:

- Address the ever increasing need of integrating disparate data sources, by moving query capabilities from IT to end-users.
- Information sharing across business units, sites, etc., i.e. break information barriers between silos.
- Master data management using ontologies (requiring less maintenance than traditional methods)
- More flexible and open extension of IT infrastructure for BI and data governance.
- Automation in business processes
- Savings in time & money

Organizational Maturity: Undisciplined

At this level, the organization the organization is suffering from undermanaged information across the company. Information is usually fragmented and inconsistent across applications/disciplines. The same data may exist in multiple applications, and redundant data is often found in different sources, formats and records. There is no strategic initiative to exploit existing data, but there is some awareness that poor data quality & exploiting of data may inhibit business performance.

Typical goals for a company at this level:

- Grow business by exploiting available data, e.g. combining different types of data to create meaningful information about customers.
- Transition to data-driven decision-making.
- Reduce risk stemming from data problems such as lost customers.
- Time and cost savings.

To conduct an assessment of a company's maturity, we have listed typical differentiating characteristics for each parameter. A company will have these characteristics to a larger or lesser degree. The list must be further developed in the next iteration. In addition, the assessment on organizational maturity will be relevant for conducting company specific risk assessments as many risks usually are linked to a company's maturity.

Parameters	Typical characteristics assessed
Business Model and Process Maturity	Conservatism regarding Open source products Misalignment of incentives to adopt new technology in the business processes Level of data dependency in the Business Model Organizational structure (e.g. departmental silos remain the biggest barrier to data sharing as this prevents cross company examination of data sets)
IT Infrastructure Readiness	Vendor lock-in in existing contracts Access rights managed centrally or in the applications Networks and bandwidth Standardization across different sites & locations. Disaster Recovery/ Fail-over/Backup strategies Perceived complexity of the solution to be implemented
Data Integration Readiness	Data quality in current systems Level of commitment to required groundwork on ontologies/vocabularies Level of understanding of business potential in integrating different sources (realizing that data integration is a critical component of their information infrastructure) Level of preparation for comprehensive data capture and delivery, linked to metadata management and data governance support Centralized terminology or Master data management initiatives

Data Governance Maturity	Enforcement of guidelines and policies for data use and access (life cycle perspective) Management of Change processes Level of data security management & resources committed to security Adherence to standards (Open source standards) Confidence towards new technology (e.g. implementing ontology maintenance regime)
People (Resources, Competence & Management)	Skills: A significant barrier to succeeding with big data will be building new skills and maintaining the right skills. (New skills can be: process knowledge, statistics, data visualization, data mining, machine learning, and database and computer programming. 3) IT departments influence on Big Data strategy End-user empowerment and understanding of information Management understanding of data challenge – ability to view entire organization & data sources Management commitment to the "long term" focus on ROI (sticking it out until one can reap benefits) Plans and strategies for collecting and organizing data in a "value creation" context

Table 5: Parameters influencing level of barriers to adoptions

[3] Gartner, Inc. | Hype cycle for big data , Aug. 2014 p 5

6 Risk Analysis

It is suggested to postpone the risk analysis development to Task 11.2. The risk analysis will be a generic framework that enables a company to identify critical prerequisites for implementing and operating Optique, and how these potential deficiencies can be mitigated.

In this phase, the project will include experience from the partners using the Alpha package and hands-on familiarization with Optique. The future risk analysis can then be empirical and based on the partners own feedbacks and experience. Currently recruiting to the partner program is a major activity of WP11. Partners are expected to represent a multitude of enterprises which will give a good basis for risk analysis.

In addition, the organizational maturity model and the barriers to adoption will provide valuable input to a risk analysis framework and this experience may be gained through further investigation of the Optique partner program.

To be aligned with industry standards within risk management, a framework to conduct risk analysis according to ISO 31000 is suggested in Appendix 2.

Appendix 1: Feature Comparison

Functionality	Optique	Data Warehouse	Business Intelligence Solutions	Ad-hoc Query Solutions	Stand-alone Analytics Tools
Fast access	Accessing the data directly in the source databases (near real-time).	New data must be extracted frequently from the source databases and loaded into the data warehouse			
Flexibility in queries	"on demand" integration of data from end-user perspective			Ad hoc also flexible (but customized by experts…)	
Query language closer to natural (domain) language	Closer to end-user language, requires ontology in place	SQL query based: not understandable for end-user. But not a repeat task to do	SQL query based: not understandable for end-user. But not a repeat task to do	NO	Can exist depending on solution (graphical language)
Ad hoc query formulation	Optique aims at enabling the domain experts to get the information they need without requiring any knowledge on how the data is stored. This is done by using and expanding on existing tools from semantic technologies	Must be passed to IT expert	Possibilities within given framework	Yes	Case by case
End-user data retrieval	Competence moves to end-user, sidestepping programming knowledge.	Must be passed to IT expert	Possibilities within given framework	No	Case by case

Functionality	Optique	Data Warehouse	Business Intelligence Solutions	Ad-hoc Query Solutions	Stand-alone Analytics Tools
Support for queries over geospatial and time-stamped data	Allows user to pose queries undisturbed by underlying data models	Lookup and exploration of data along geospatial and temporal dimensions must be explicitly designed into data-models and/or transformations.	Exploration of data along geospatial and temporal dimensions must be implemented case-by-case into BI-solution, and requires the implementing expert to have knowledge of the underlying structure of the data.	None	Case by case
Data accounting/arithmetic capabilities	Some support for aggregation operators	Yes	Yes	Yes	Yes
Integration across databases (different types of DB)	"On demand integration of data" flexibly connecting concepts in the query interface to federated data sources	Predefined mappings (ETL based) Some of the mappings can be highly complex, especially when the nature of the sources differs a lot. (NB Maintenance, Risk of errors)	Based on functioning DW	Case by case	Case by case
Data (data models) maintenance	Ontology based, easily expandable	When the number of data sources increases, a significant effort has to be made to keep the mappings consistent with the underlying data models.	Based on functioning DW	Not reusable model if change in context	Not reusable model if change in context
Linear and modular scalability	No large investments needed to add a new information source. Module based	Linear scalability possible, modular more complex. Risk of hitting capacity several times	Linear scalability possible, modular more complex	Not applicable	Not applicable

Functionality	Optique	Data Warehouse	Business Intelligence Solutions	Ad-hoc Query Solutions	Stand-alone Analytics Tools
Extract new information (analytics)	Lower threshold to initiate new info. Add value by giving domain experts (closer to discipline) the possibility to give new meaning to existing data	Must be passed to IT expert	Possibilities within given framework	Case by case	Case by case
Disparate sources linked with common language (semantic equivalence)	The language used to query within a domain is always applicable (only translation/mapping changes)	Tailored to existing systems, requires maintenance and updating of translation	Based on functioning DW	Not applicable	Not applicable
Inclusion of data streams	Yes	Data warehouse will have latency due to data loading	Based on functioning DW	Not applicable	Not applicable
Master data management	More dynamic, decide what is Master data rather than developing MDM module	Often MDM module is required	Based on functioning DW	Not applicable	Not applicable
Inclusion of unstructured data	Not so good	Not so good	With some solutions (e.g. Hadoop)	Not applicable	Case by case
Infrastructure requirements	non-invasive, will run on existing IT infrastructure	necessary to migrate existing data sources to new infrastructure	Based on functioning DW	Not applicable	Case by case
Confidentiality/Access restrictions (rights management)	No ACL module? Need a very independent module for access rights (if not still dependent on existing ACLs)	Exists	Exists	None	None

Appendix 2: Risk Analysis Framework

A risk analysis process according to ISO/IEC-31000 with focus on Optique will be performed. After establishing the overall risk picture, the process will be performed repeatedly to review status, consider the effect of barriers and possibly identify new security risks.

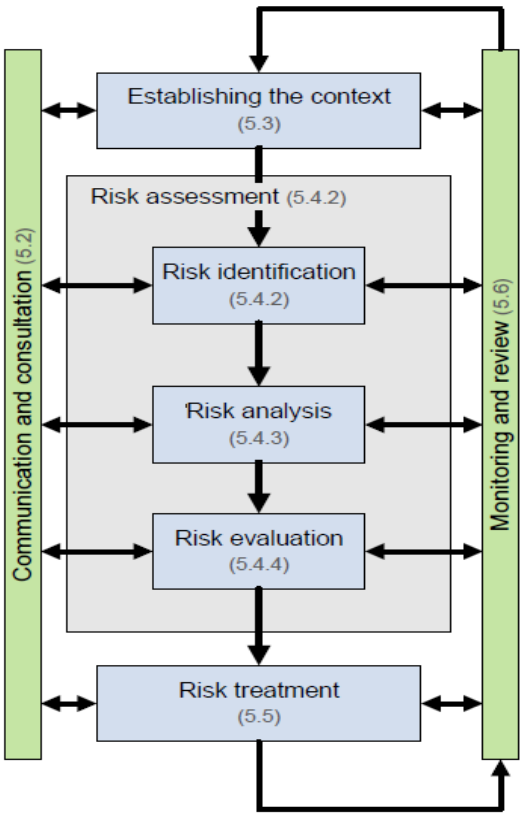


Figure 2: ISO 31000 Risk Management

Initiation, Establish the Context

An Optique risk is a possible event which can occur at an enterprise implementing Optique with a positive, a negative outcome or both. There is a certain probability for the event to occur and there can be a magnitude of reasons (causes) and a number of possible consequences. Some of the Optique risks may be common to several enterprises implementing risks while other will be specific for an enterprise depending on its prerequisites and modi operandi.

The needs of an enterprise, its culture, financial situation, technology basis, etc. are examples on specific factors that should be considered when a risk analysis is planned performed for an enterprise and that will have to be considered when the context for a risk analysis is to bed defined.

Securing management support an engagement is a key success factor for a. The purpose of a risk analysis is to provide information for decision support.

Risk Identification

Identification of risks for inclusion in a joint Partner program risk register should be a mutual contribution from all involved in the Optique program. Presentations focusing on risks should be given at the Partner program conferences by both the project team but also by partner program members. A common and available risk register would also be a contribution to enterprises evaluating to implement Optique and a starting point to learn from other.

Specific techniques can be used for identification of more specific risks for an enterprise. Access to and contribution from key personnel who knows the enterprise well, its management team, key stakeholders who can contribute with knowledge and experience are key in most of these techniques.

A first list of risks regarded as being common to enterprises implementing Optique will be established and included in the D11.3 report.

Risk Analysis

After the initial risks are identified, the risks are reviewed and assessed. Several techniques are available for doing both quantitative and qualitative risk assessments and several measures for classifying the severity and possibility for consequences can be used.

The initial risk register will contain the results from a first risk analysis and will suggest a scale for both consequence and probability measures.

Risk Evaluation

A plan for mitigation the identified Optique risks will be established and adequate barriers for preventing the unwanted event to occur, discussed. Suggested planned actions for reducing the consequences if the unwanted event occurs will also be part of the action plan.

Different strategies for mitigating the security risks can be used. This includes:

a. avoiding the Optique risk by deciding not to start or continue the activity that gives rise to the risk
b. taking or increasing Optique risk in order to pursue an opportunity
c. removing the risk source
d. changing the likelihood
e. changing the consequences
f. sharing the Optique risk with another party or parties
g. retaining the Optique risk by informed choice

Risk Treatment

The effect of barriers should be regularly reviewed. Also the complete Optique “Risk picture” should be regularly reviewed to see if additional risks are identified, if some of the existing risks are no

longer valid, if there are reasons to perform changes to likelihood or consequences, the risk register will be updated and the changes reported.

Monitoring and Review

Risks may develop over time and should be regularly reviewed. This may be due to changes in the external or internal context or because of knowledge and experience gained.

Communication and Consultation

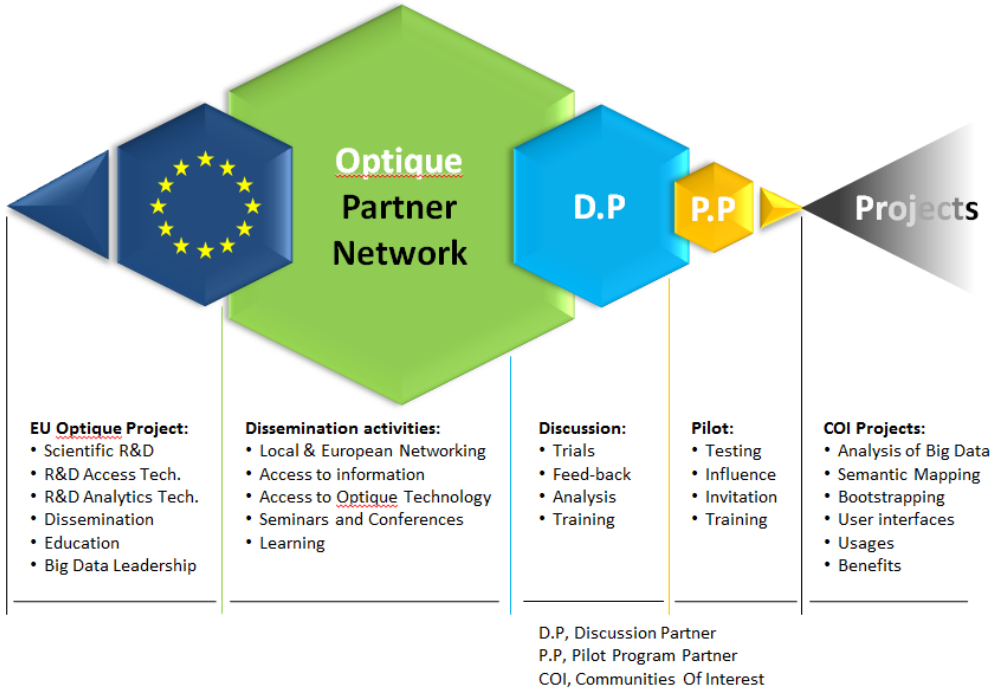
The purpose of a risk analysis is to provide adequate information as a basis for decisions to be taken by an enterprise. Effective communication to decision makers is therefore important.

The DNV GL tool Easy Risk Manager (ERM) will be used for risk monitoring, follow up and communication in the work in WP11.

Appendix 3: The Optique Partner Program

The first meeting in the partner program was arranged 25-Jun-2014 in DNV GL premises at Høvik, Norway. About 30 participants from a broad range of Norwegian enterprises after a direct mail campaign to a selected group of persons/ enterprise of about 60. The next meeting in the partner program is scheduled for Mars 2015, followed by a second meeting in the autumn of 2015 and two meetings in 2016.

The illustration below gives an overview of the Partner Program Network. (Acronyms - Discussion Partner (D.P), Pilot Partner (P.P) and Communities of Interest (COI).)



In the tables on the following pages the details of the proposed different partner programme categories are described.

Optique Network Partner – Gaining knowledge

Local and European networking.	A Network Partner will connect, meet and exchange impressions and experiences within the network. A Network Partner will be classified in accordance with its business sector i.e. Banking, Government, Transportation, Oil & Gas, Defense, etc. Requirement: Network Partner will budget for staff participation, and they will assist the project finding new members to expand the contact list.

Access to information.	A Network Partner will receive information from the Optique Project Group. The information will be in form of messages, presentations, whitepapers, research-papers, brochures, flyers and reports on progress and dissemination. Requirement: give feedback on received information.
Access to Optique technology.	A Network Partner will receive demonstration- and Alpha versions of researched technology, for download, implementation and test. Requirement: give feedback on technology.
Large meetings.	A Network Partner will have an opportunity to attend Optique Summits, Seminars and Conferences. Be an active part of the project; participate, discuss and give valuable feed-back. Requirement: active participation.
Learning	A Network Partner will have an opportunity to attend Optique learning classes. There will be learning openings in conjunction with the large meetings. These are one full day of up-to-speed classes, background and current status of the Optique technology. Classes will be held by Optique project experts, and they will be at self-cost price. Requirement: participation.

Optique Discussion Partner – Go from theory to practice

Trials	A Discussion Partner decides to apply Optique concepts and technologies for their own enterprise, situation and benefit. These partners might have Big Data assets that are difficult to exploit or systems that generates vast volumes of data/information. Regardless of situation, Discussion Partner needs to figure out what to do and how to do it. Solutions and recommendations can be provided from the project as free or paid services. Discussion partner would consider to test out technology at Optique site or own environment. Requirement: Try out Optique concepts and technology.
Feed-back	It is very valuable for the Optique Project to have a Discussion Partners feedback and point-of-views. In order to simplify the feedback, the project recommends a structured way of testing technology which should be used for these types of trails and discussions. Requirement: Use Optique standard feedback documentation
Analysis and analytics	Different branch sectors and its Big Data assets will develop different types of enabling technologies; i.e. models, ontologies and mapping

	schemas, and analytics tools. The Discussion Partner will document the type of analysis and analytics that is required and how well this is covered by Optique technologies and/or staff services. Requirement: Give feedback on analysis.
Training	In conjunction with the large meetings, there will be learning opportunities especially for Discussion Partners. These are one full day of practical testing on how to utilize Optique concepts and technologies. Classes will be held by Optique project experts, and they will be at self-cost price. Requirement: Participation.

Optique Pilot Partner – Hands-on implementation

Testing	A Pilot Partner have decided to start-up and finance a pilot project to further test out the capabilities of Optique concepts and technologies. The pilot will serve as a clarification on objectives and what is required in people, funding, time-enabling and analytics technologies. Requirement: Pilot partner should budget for internal- and external staff resources, set up a pilot program and investments in technology.
Influence	A Pilot Partner has gained significant experience and will be the leading representative for an important business sector. As such the Pilot partner should be given opportunity to influence Optique concepts and solutions. Requirement: Pilot partner should budget for time to interact with Optique project, for both development and dissemination.
Invitation	A Pilot Partner will be invited to meet with and present its findings for the Optique Steering Committee. Invitation to the annual Optique project meeting. Requirement: Pilot partner should budget for travels and time to meet the leadership and development resources of Optique.
Training	A Pilot Partner needs deep, focused and adapted training to understand what to do and how to do it. The training will cover all aspects of; analysis of Big Data assets, semantic mapping (ontologies), bootstrapping, setting up and adapting user interfaces, usages/analytics and benefits expectations. Requirement: Pilot partner need to budget for training of staff resources that would be involved in the pilot project/s.

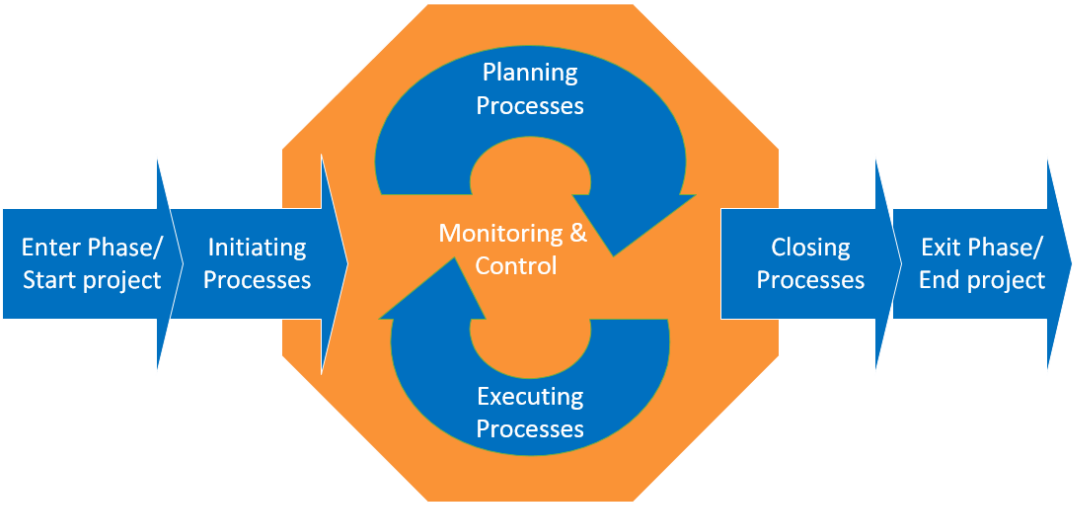
Optique Partner Program planned activities 2015

- Optique Partner Program Contact list (Expand to > 500 names)
- Optique flyer, update of previous flyer, January
- Optique website, update of Partner Program information, January
- Optique Alpha package (for dissemination at the next summit), February;
    - Optique Software, The Y2 prototype of the Optique platform (D2.4)
    - Proper documentation/training material (D10.7)
    - Demo system including Fact pages (D10.9)
    - Marketing collateral; videos, publications, whitepaper
    - Use-cases and scenarios; Data Center, Musicbrainz
- Optique Technical whitepaper/s
- Optique Partner Program flyer, February
- Optique COI-Statoil use-case flyer
- Optique COI-Siemens use-case flyer
- Optique Partner maturity model report
- Optique Marketing plan, second iteration
- Optique Partner Joining/Signature Page and Certificate
- Partner Meeting; Network summit, February
- Partner Meeting; Network Fall Conference, September
- >40 Presentations
- Optique first benefit analysis
- Optique first pilot program, OREDA, AIBEL, DNV GL, NSB

The first training course is being planned with participants from Engineering Company Aibel and DNV GL. Training material is currently not available but existing project material will be used.

Implementation Plan Outline

As required in D11.3 a white paper describing how to implement an Optique system will be produced in Y3. The implementation plan will be built on the PMI process model as illustrated below:



The following phases in the Optique implementation plan will be detailed described and aids for managing an Optique implementation project will be included in the white paper.

Enter Phase/ Start project

The Optique implementation plan is triggered when the enterprise management decides to start the implementation of an Optique system.

Initiating processes

During the initiation processes the mandate for the Optique implementation project is defined and the main stakeholders are identified. The initial scope is described and the needs of the main stakeholders are identified and documented. The high level business expectations to implementing the Optique system is formulated and approved by enterprise management.

Planning processes

The planning processes consist of those processes performed to establish the total detailed scope of the implementation of Optique, define and refine the objectives and develop an Optique implementation plan and can be performed iteratively to deliver parts of the Optique system in steps. This to reduce risks by being able to verify, test parts of the system, and implement the Optique solution in steps. An iterative implementation strategy can also be a means to gain "quick-wins" where obvious positive effect situations exist by implementing Optique that can be easily exploited.

Executing processes

Necessary infrastructure to install and operate the Optique system is provided and made available for the project team. The Optique implementation team is mobilized and training of the team is initiated. The basic Optique modules are installed. Ontologies are built and mappings are established. Queries are formulated by End-users. If procurement is planned, this is effectuated. Results are evaluated and quality assurance performed.

Monitoring and control

Monitoring and controlling an Optique implementation project consist of those processes needed to verify that the project is proceeding as planned and performing as budgeted. These processes include monitoring of progress, cost control, verifying that quality assurance are performed and has the effect as expected.

Closing processes

When the Optique implementation project has achieved its goals, or the project for some other reason is terminated, all project results must be secured and prepared for reuse. Reuse can be as experience documentation for future projects and also to be reported to the Optique partner programme as experience transfer to other organizations in the process of implementing Optique.

Exit Phase/ End project

The project is terminated and operation is initiated. Project experiences are presented to the partner program meeting.