SEVENTH FRAMEWORK PROGRAMME

Networked Media

Specific Targeted Research Project

SMART

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Search engine for MultimediA environment generated contenT

D7.2 Business Models, Utility Metrics and Participation Incentives

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Summary of the document

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Abstract:	*This document contains the information about business models, utility metrics and participation incentives suitable for the SMART multimedia search engine. The emphasis is put on business models and utility metrics that are gainful for all stakeholders of the SMART value chain.*
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1 Executive Summary

Scope

This deliverable describes the business models, utility metrics and participation incentives of the SMART project in relation to exploitation and commercialisation of the project's outcomes. The consortium has analysed the situation and context of the SMART project and some business plans have been developed to direct activities throughout the remainder of the project and the partners have converged on several key ideas.

Audience

This deliverable is of interest to various stakeholders of the SMART project: individuals, partner organisations which are not active in the day to day running of the project but with an active interest in the value of the project's outcomes, including the European Commission and finance departments of project' partners who wish to see how a return on the investment can be made; but also for potential users of the SMART eco-system, whether on the search side (end users), input side (sensor owners) or third party developers who wants to use SMART, who wish to know how they might interact with the project and influence business decisions at this point; and finally programme participants who may wish to share best practice in business models, utility metrics, participation incentives and exploitation activities.

Summary

This document presents the tactical approach SMART takes towards exploitation and commercialisation of the project results. This is based on following inputs: project' outcomes, market vision, technological innovations and limitations; and partner interests. The rationale, progress and next steps from each of the project' partners views is presented, along with their business models, utility metrics and other ideas towards successful project commercialisation.

2 Introduction

This document explores the role of the business models, utility metrics and participation incentives in the SMART project in capturing value from the end stage of the created technology. A successful business model creates an empirical logic that connects technical potential with the understanding of economic value.

The business model unlocks latent value from a technology, but its logic constrains the subsequent search for new, alternative models for other technologies later on—an implicit cognitive dimension overlooked in most discourse on the topic. We explore the intellectual roots of the concept that offers a working definition and show how the SMART technologies could be moved to the enterprise via viable business models. Furthermore, the business models, which will be employed by individual partners as part of their exploitation plans are also presented as concrete instances of the wider business models of the project.

As part of the deliverable we also specify a number of utility metrics, which could be used for accounting, metering and charging associated with the SMART platform. Such utility metrics could be proven very useful towards offering SMART according to a cloud-based pay-as-you-go model. The metrics presented in this deliverable have their roots in search engine, IoT (Internet-of-Things) and cloud computing technologies.

The SMART project has evaluated the technical potential of these metrics through its own business models, while participation incentives can became more successful did so through evolving business models that came to differ substantially from the other open source business models and products.

Note that the present deliverable does not elaborate on the partners exploitation strategies. Hence it does not also illustrate concrete actions for attracting potential customers and generating revenue based on the business models that are presented in this document. The exploitation plans of the project partners and of the project as a whole (i.e. joint exploitation strategies) are presented in a dedicated deliverable, namely D7.5.2 (which is the final release of deliverable D7.5).

3 SMART Business Models

At first glance, there seems to be a broad understanding regarding business models. However, a more thorough analysis of existing resources paints a different picture. The term 'Business Model' often remains undefined and a consensus on the elements of business models is lacking. An analysis of various sources, such as electronic databases, conference proceedings, white papers, itself supports this statement.

Though, business models are largely believed to determine the success of a single product. To establish some organisation and to identify the critical components of the SMART Business Models, the existing definitions and approaches were analysed and led to several models defined by the SMART project partners.

In the deliverables D7.5.1 and D7.5.2 the theoretical Business Models proposed for the SMART platform and its component pieces have been presented. The steps towards defining the business models (largely done in D7.5.1) are:

1. Identify potential business models
2. Analyse the possibility, likelihood, pitfalls and benefits of each model
3. Establish a business plan for delivery (including governance models and financial forecasts)

Using a technique that creates business models through classifying different value chain activities, multiple business scenarios were generated and analysed. From the scenarios identified, four credible business models were selected as meriting further analysis. These are:

- **Idea I: Searchers pay**
- **Idea II: Sensors pay.**
- **Idea III: Advertising-based model.**
- **Idea IV: Analysis package marketplace.**

Four business models are proposed. The main points and next steps are summed up in the following table:

Model	Main selling point	Main stumbling block
I: Searcher pays	Fits well in niche deployments. Easy to set up. Well understood model Variety of pricing models	General public have a low propensity to pay for online services
II: Sensor pays	Fits with the general trend of online services being free at point of use.	Difficulties identifying business case for sensor providers except in very niche applications.
III: Advertiser pays	Fits with the general trend of online services being free at point of use.	To be competitive users must present a very high value to advertisers, for their profile and/or as they are difficult to target through other means. Additional difficulties come from when the searcher is not required to be registered (one does not need to register for Google, however one is registered in Twitter and Facebook). If the user is not registered then the profile pre-

		sents less value to the advertiser.
IV: Marketplace	Rapid, free and varied development of analysis tools will add significantly to SMART value.	Need a "Killer App" to bring in users and demonstrate value to developers. Introduction of third parties splits profits between SMART and contributors. Possible legal and ethical barriers to 3rd party involvement.

Table 1: Overview of SMART Business Models

After reviewing the proposed business models the SMART project partners have decided to focus on the following three solutions:

- **Technology Solution Provision (Turn-key solutions for smart cities)**
  - Mostly for smart cities, but also service providers and operators of smart city services (such as the mobile network services providers). The latter providers are starving for novel revenue generating services. SMART enables the development and operation of such services notably through the combination of social search with search over sensor-based information.
  - Several smart partners (e.g., TELESTO, S3LOG, ATOS) are basing their business activities around the provision of novel turn-key to smart cities and smart regions, but also to service providers/operators of such services.
- **Provision of Consulting and Training Services**
  - Support solution developers using the SmartSearch platform on the basis of training/education and consulting services, overall helping them to build their solutions
- **Apps**
  - This is a mainstream business model, which is associated with the proliferating number of mobile devices (i.e. tablets, smartphones) and the wave of applications that is being developed for them. The relevant business model includes direct Sales/purchase of apps via popular Marketplaces (AppStore and GooglePay). SMART is already prepared for this business model, given that its (SMART Search based) apps developed in WP5 (e.g., for venues recommendations) are already part of those marketplaces.

What follows are the *actual* business models that the partners of SMART are considering using. There are presented as concrete instances of the above-listed business plans.

Atos

The basic model for exploitation for Atos for the results of SMART, at least in the short term, is to include these results as part of the MyCity (Atos SMART Cities) and GEMMA (112 and Emergency Management).

An integral part of the basic business model in many commercial projects is to earn revenue by transaction rather than by charging for licensing or overall project fees. Due to the uncertainities involved, in the short run this is not considered feasible for SMART but it is being looked at as an option in the longer term. Within the MyCity portfolio these transactions would include:

- payment services (Atos is the European leader in online payments)
- citizen, police or other user transactions with the system
- searches

As part of the GEMMA portfolio, a transaction model is probably less feasible. Here, the services would be charged based on:

- integration costs
- periodic payments for the entire system (monthly, yearly) based on city size and data volumes

In both of these cases, in the short term, it would be the client, i.e. sensor (local police or municipality for example) who would be the pay for the services. In the longer term, as mentioned above, if it is shown that that the data being collected and analysed in SMART has sufficient value then other models will be considered.

AIT

AIT's model for business exploitation is built round the provision of consulting and training services for the SmartSearch open source platform. AIT is positioned in the open source market for IoT-based products and services based on several open source projects, including OpenIoT (github.com/OpenIotOrg/openiot/wiki) and AspireRFID (wiki.aspire.ow2.org). Its model for exploiting the SmartSearch open source platform will be based on the development of training materials and documentation, as well as on their use for the provision of consulting services to solution providers using parts of the SmartSearch platform, AIT's services will target the areas of solution feasibility analysis, solution architecture design, as well as technical consulting on the integration of SmartSearch components.

On another forefront AIT will attempt to commercialize its visual signal processing solutions (including crowd analytics technologies). For this purpose AIT has founded a spin-off company (Dynasense), which will be dedicated to design, develop and deploy turn-key solutions based on the above-mentioned technologies.

IBM

The model for exploitation of the audio analysis tools is by combining them with existing IBM offerings. There are several direction for using the audio analysis tools. For example: IBM has various "Smart Cities" products and projects (e.g. IBM Intelligent Operations Center). Within this area the audio can be combined with video sensors and integrated into IBM smart security systems.

Another direction is to integrate this as part of the cognitive-computing initiative. Both the audio and the speech processing can be included within the IBM Watson products. This can enhance the interaction models between the users and Watson and allow to create various solutions which will use those tools.

For speech verification, the main exploitation direction is through the IBM MobileFirst products. By enabling biometric verification, which includes speech, the users can enjoy a secure mobile systems without the need to use complex passwords.

TELESTO

Telesto aims to exploit the results of the project, as part of its overall service offering for municipal projects. The project has also helped the company establish itself as an innovative solution provider and has given it valuable insight on new types of services. In one such case Telesto has recently delivered the "InvestOTA.gr", which is an investment opportunities portal for PPP (Public Private Partnerships). This portal is based on the same principal of Web2.0 intercommunicating widgets that may be used by 3rd party developers (developed as part of the "Mashup Libraries" in SMART).

As part of its exploitation plan, the company has already proceeded to form partnerships with IT companies as part of their portfolio of solutions for "Smart City" projects. In this case an integrated systems and services provider (one such example is available in D.7.5) will subcontract to Telesto, the parts of the project relative to real-time content and services. This know how is vital for our company (and the consortia, in which it participates) as it seeks to differentiate its product offering from the (fierce) competition.

Furthermore we consider the opportunities presented by assets such as the Social Network Manager and the Web2.0 mashup libraries (wholly owned by the company) as significant towards reaching other markets beside the public sector and believe that we need to work towards specifying solutions that build on such as-

sets, along with the rest of the assets jointly developed by the consortium members.

PRISA

PRISA' vision about exploitation of the results of the SMART project are around two different lines:

- Include the events detected by the SMART Search Server infrastructure in some of our news live streams and monetize this through ads
- Include the information coming from the SMART Search Server infrastructure in our mobile ap-plications and monetize this through ads and/or In Application Purchases.

S3Log

S3LOG is planning to approach to exploitation. Two different business models, both B2B, could be more deeply analysed:

- **SMARTCOP AS A SERVICE:** as a part of this exploitation model user's sensors network will be integrated with S3LOG infrastructure:
  - Payments evaluated with a "as a service" model (costs elements and metrics driving the pricing policy to be identified).
- **SMARTCOP AS PRODUCT:** this business model includes
  - Setup and integration activities costs
  - Licensing structure based upon:
    - number of sensors connected;
    - configured and activated SMART modules;
  - number of operator connected;
- Maintenance & support periodic fee.
- Software updates subscription.

University of Glasgow (GLA)

GLA's model for exploitation of SMART considers two aspects: (a) involvement as background intellectual property in further European Commission FP7 & Horizon 2020 initiatives to increase the technology readiness level (TRL); (b) engagement with cities and other companies with interests in social media and sensor analytics, with a view to forming knowledge exchange partnerships or consultancies through deployments of the SMART software.

For instance, for the former, GLA is using the SMART software stack within the SUPER FP7 project, which encompasses social media analytics and usage scenarios in emergency/disaster response.

In the latter case, for a deployment of SMART technology within a city, we primarily envisage that it would be paid for by the sensor provider (i.e. the city council). The alternative of searcher pays could be supported through the use of micropayments from mobile app stores supplemented by advertising revenue; however we don't believe that this alone would cover the costs of running the search engine. Indeed, our recent investigations suggest that SMART technology is of interest to sensor providers not just to address citizen information needs (such as event retrieval and venue recommendation) but to help the city itself track events and measure their own KPIs (such as venue attendance). This suggests that as such, they would be more willing to invest in such technology.

Imperial College London

Imperial College's aim in terms of business exploitation is three-fold.

1) Providing consulting and training services for the modules and components that have been developed for SMART namely the reasoning wrapper and the reasoning component based on twitter da-ta. These components can be potentially useful for different types of municipal or any other project which deals with event recognition and reasoning (research or commercial).

2) Event recognition for financial institutions using social network data.

There is a current project in the electrical engineering department of Imperial College which focuses on using different engineering techniques to solve the issues in the finance industry.

It is planned to use the component developed in SMART for research in this application as the tweets can be filtered to be only related to a special keywords (this can be considered a sub-feed) such as the name of a company (e.g. Barclays). In this case events which are inferred by the reasoning component will be events related to a particular company (rather than a particular venue or place) which can be beneficial in investment decisions.

There are few asset management firms which are particularly interested in this type of research such as Schroders and BlackRock as they have started recent initiatives to use sophisticated data analysis techniques for financial decision making.

For example see: http://www.efinancialnews.com/story/2014-02-28/schroders-joins-blackrock-on-big-data-spend

4 SMART Utility Metrics

4.1 Motivation for Defining Utility Metrics

The SMART search platform enables multimedia search over environment-generated content. Furthermore, these services are typically deployed and offered as a (search) service to their end-user. The SMART search service is therefore in line with recent trends towards cloud-based deployments and pay-as-you-go models, which can also be directly linked to the SMART business models. In particular, a range of SMART monetization models could be based on the use and utility metrics for the SMART services. Such utility metrics could be also used to drive stakeholders' participation in the SMART system through enabling sensor and data stream providers to gain credits that they could later exchange with searches over the SMART platform. Moreover, utility metrics can be used for accounting and billing over the SMART platform. Overall, utility metrics can enable:

- **Service Monitoring:** Utility metrics can measure user engagement & satisfaction with the SMART platform, while also monitoring the health of the SMART search service. For instance, as users likely to be dissatisfied with a slow search engine [Kharitonov2013], monitoring the response time of the search engine is important. Moreover, the search engine is only useful if its results satisfy its users. Satisfaction cannot be directly measured, but can be approximated by examining user interactions with the provided results.
- **Billing & Charging**: Utility metrics can serve as a basis for charging users for the use of the SMART search engine. To this end, utility metrics should be fed as input to appropriate charging models. Note that charging can be performed for individual searches, but also for the use of SMART based applications (such as the live news and security/surveillance applications).
- **Accounting**: Utility metrics could facilitate the calculation of the usage of the various components and services of the SMART platform, thereby giving rise to a number of service and resource management functions for the SMART platform.
- **Incentives for participation to the SMART ecosystem**: The success of the SMART platform will highly depend on the willingness of content providers (e.g., sensor communities, data stream providers, infrastructure providers, smart cities, smart communities, individual citizens) to setup edge nodes and/or to contribute data streams to the SMART platform. In order to motivate the participation of these communities to the SMART ecosystem incentives should be provided. Utility metrics can provide a vehicle for keeping track of units/points that could be later exchanged with services by the SMART platform.
- **Business Models**: A wide range of business models could be developed over sets of appropriately defined utility metrics. These business models could be based on access to SMART services on the basis of a cloud-based pay-as-you-go model. The foundation of such a model would be the calculation of charges according to utility, i.e. based on utility metrics of the SMART platform. In this context, the various utility metrics could also serve as a basis for pay-as-you-go business models for the SMART platform and services.

In the following paragraph we review possible utility metrics for the SMART search platform.

4.2 SMART Utility Metrics Specification

SMART utility metrics are inspired from three disciplines that are closely related to the SMART Search platform, namely: (A) Search Engines, given that SMART itself is a search engine/platform; (B) Internet-of-Things, given that SMART search sensor device and social networks derived data streams, notably data streams that provide observations about the surrounding environment; (C) Cloud computing, given that SMART could be deployed in the cloud. Since the ultimate service of the SMART platform is a search service, most of the utility metrics are closer to the concept of a search engine, rather than to low-level cloud infrastructure metrics (e.g., Power consumption, CPU utilization, memory utilization, storage utilization). In particular, the following metrics could be used along with the SMART business models, but also for accounting purposes:

- **Number of Queries**: This metric refers to the number of queries that the end-user is allowed to ask the SMART platform. It is a metric easily understandable by end-users, since it signifies the number of questions that an end-user is allowed to ask the SMART platform.
- **Querying Resource Usage:** As users are not willing to wait for a slow search engine to provide results [Kharitonov13], various metrics have been examined in the literature that measure the time taken for a search engine to respond to a query. In general, for modern efficient search engines deploying techniques such as WAND, it is difficult to predict how long a query may take to be serviced, however recent machine-learned query efficiency prediction techniques [Macdonald12QEP] have been making inroads into this problem. The efficiency of a deployed version of the search engine would be important for deciding on charging mechanisms – indeed a service level agreement (SLA) may require not just average response time guarantees, but also 95th or 99th percentile guarantees [Jeon14Tail]. Charging would then be based on the amount of server resources (and energy consumption) necessary to maintain the SLA, based on historical query volumes and efficiencies, as well as future query efficiency predictions for increased corpora size (i.e. more sensors or edge nodes).
- **User Engagement:** The direct success of the SMART search engine will relate to how it can satisfy the information needs of its users, i.e. if the result lists provided by the search engine addresses users' information needs. Satisfaction is difficult to measure accurately from the users' interactions with the results lists, however various predictors are now being proposed in the literature [Diriye2012]. In its most general case, an abandonment of the search engine by a user, not interacting with any results or returning can be indicative of low quality results[1]. Depending on the usage scenario, further utility metrics can be defined, inspired by the serving of ads within search results, and the user's interactions thereafter. For instance, consider the venue recommendation scenario supported by SMART. If SMART suggests a restaurant, and the customer visits the restaurant page, or even books a meal, then the venue must pay the search engine for that view. For effective exploitation, this would require a partnership with a venue listing company, such as Yellow Pages/Yell. An implementation detail of the business model would of course deciding between % of restaurant bill total or just the fact that page was viewed.
- **Sensors and/or Social Networks involved in Queries**: This metric can be calculated on the basis of the number and type of sensors involved in answering a given set of queries, as well as by the number and type of social networks to be involved in the same queries. Note that the number and types of sensors and social networks involved in answering a query in not typically visible to end-users of the SMART platform. Hence, such a metric could be computed and used by providers of the SMART services.
- **Types of Sensors and Data Streams involved/used in Queries**: Apart from the number of sensors and data streams involved in answering queries, the type of sensors and data streams should be used in utility metrics calculation. To this end, a user-defined cost could be assigned to each sensor type.
- **Location and Number of Edge Nodes involved**: The utility of a query (or even of a set of queries) could be also calculated on the number and location(s) of the Edge Nodes involved in answering them. The location covered by a given Edge Node can be a crucial metric, which could be associated with a provider-defined cost. Similar to the previous metric, this one is appropriate for service providers and less understandable to end-users.
- **Volume of Data Retrieved**: This metrics refers to the volume of data (i.e. number of bytes) retrieved by users of the SMART search engine during a given number of searches or over a given time interval. Moreover, while a search engine can use its existing inverted index data structures to efficiently identify documents or events, the retrieval of metadata information about those items for the purposes of presentation to the user can be expensive. Changing the amount of information necessary to present can therefore reduce the amount of network and server resources necessary. In the scope of a search application, volume of data could be calculated for the course of an application session. This metric is appropriate for implementing volume-based charging schemes.
- **Time/duration of the SMART Session**: This metric is defined by the timing boundaries associated with

[1] Exceptions are possible – if enough information is presented in the result list, the user's information need can be addressed by the result list without any further interaction, known as a *good abandonment.*

the use of the SMART platform. In particular, it signifies the possibility of using the SMART platform for a specified duration. It is assumed that in this duration the user can pose any number of queries to the SMART platform.

Note that combinations of the above-listed utility metrics are also possible based on appropriate weights (i.e. utility metrics calculated based on weighted formulas over the various metrics outlined above).

5 SMART Participation Incentives

An empirical research on open source software response has given insufficient attention to the fundamentally different nature of SMART Participation Incentives versus other open source competitive products on market.

Users who join an open source network have, in general, suboptimal incentives to contribute to the network, because of the externalities that exist between them. The result is an inefficient network where the overall levels of contribution are less than would be the case if each peer acted in the interests of the entire network of peers.

Participation Incentives provided in the form of prices or contribution rules that require no money transfers can play an important role in reducing these inefficiency effects.

The problem in designing such incentive schemes is information: Designing an optimal incentive scheme requires complete knowledge of the types and preferences of the individual peers and their identities.

In this section we want to discuss the above issues in terms of a simple but representative example by introducing the basic concepts and models. We then investigate the practical issue of designing simpler incentive schemes requiring less information and compare their efficiency loss to the optimal. We can see that these schemes converge to a fixed proportion of the full information optimal as the number of users in the network becomes large. This result means that it is not necessary to collect large amounts of information, or to undertake complicated software coding, in order to implement the correct incentives in a large open source network.

We present a simple theoretical model which highlights participation option in the open source domain.

Social Media

- if people provide check-ins then they will have better personalization for their recommendations.

Sustainability, ecological issues, weather issues

- some people may participate for altruism (things like reporting high pollution, flooding, …).
- crowdsourcing.

Data source organizations

- can provide data in exchange for search possibilities
    - For their own data (for themselves, for others).

Based on utility metrics: Sensor / Data Providers should be granted credits that they could exchange to SMART services.

6 Conclusions

This deliverable has reported three important tools for the partners' exploitation strategies, namely:

- A set of business models that could be used for generating wealth based on the SMART platform and applications.
- A range of utility metrics which can be used for accounting, metering and charging. Such metrics could be particular useful towards offering SMART according to a cloud-based pay-as-you go business model.
- Participation incentives that are likely to be used to motivate participation of stakeholders (notably sensor/data/content providers) to the SMART platform (and overall ecosystem).

The above listed tools should be considered in conjunction with the exploitation plans of the SMART partners, which are detailed in deliverable D7.5.2.

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