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► **To cite this version:**

David Reymond. Digital services governance with AGIMUS. Mélanie Ciussi; Marc Augier. Proceedings of the 12th European Conference on e-Learning, 2, Academic Conferences and Publishing International Limited (ACPI), pp.420-430, 2013, 978-1-909507-82-1. sic_01809841

HAL Id: sic_01809841

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Submitted on 11 Jul 2021

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Digital services governance with AGIMUS

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Résumé: Aujourd'hui 98% des étudiants ont accès à un bouquet de services numériques au travers des environnements numériques de travail. La mesure de l'utilisation des services est pendante de leur coût de déploiement. L'obtention de données d'utilisation locales pour un bouquet de services est relativement directe mais elle est dépendante de la technologie. De surcroît, ces données ne permettent que des comparaisons autarciques et temporelles à usage performatif. Pourtant ce type de données exemptes de toute considération technologique (et évidemment anonymes), couvrant le territoire ouvrirait à l'analyse comportementale statistique. D'un point de vue du fournisseur de services, au niveau de la gouvernance, il peut être intéressant de construire aussi d'autres indicateurs tels le nombre de services offerts et leur taux d'utilisation respectifs. Nous montrons dans ce qui suit comment éviter les limites des disparités technologiques des services afin de déterminer des niveaux d'utilisation de référence qui permettraient la construction d'une politique de développement des services numériques. Le système Agimus, libre et ouvert, est utilisé pour générer des indicateurs. En s'appuyant sur les référentiels nationaux (SISE et Supann), nous montrons comment la syndication de données d'utilisations regroupées et normalisées par établissement, puis par Université Numérique en Région (UNR) puis au ministère permettent d'établir des mesures indépendantes des technologies afin d'élaborer des connaissances sur le comportement des utilisateurs (par filière, catégorie d'usager, par niveau d'étude), de déterminer degré et la profondeur d'utilisation des services afin d'élaborer des référentiels pour guider la politique de développement du numérique. Les métriques sont issues d'indicateurs fins comparables entre établissements universitaires.

Abstract— Today 98% of students have access to a bouquet of digital services through their cyberspace. Pending of settlement and maintenance costs, the question arises to measure the usefulness of the panoply of services deployed. If this is straightforward locally for a bunch of services, the same question independently of the technology would offer more details on student's behaviour. From the point of view of an entity providing digital services, at the level of governance or policy makers they may also need other indicators such as the number of services offered and their respective rates of use. We show how to avoid most technical issues, and we deal hereafter with determining the good levels of usage.

The Agimus system, an open and free application is used to generate a bundle of indicators. Agimus is based on normative repositories of description of user profiles. We'll show how the device paves the way in a quality approach for improvement of the digital services provided by one or more organizations, the co-construction of knowledge, among others, on the statistical behaviour of the client users. Examples of indicators implemented will be taken on institutions of higher education digital services.

Keywords: Cyberspace, usages; indicators; log analysis; consumer behaviour; policy making

1. INTRODUCTION

Indicator systems have emerged in the context of increased awareness of the importance of analysing performance. On the one hand, the importance of data to inform rational decision-making needs no further proof, and in the context of policies designed to give more autonomy to institutions, verifying the performance of these institutions has become an obligation. Indicators are the main matter for ranking institutions, and in the university context, these rankings nowadays play a significant role in university decision making (Hazelkorn, 2008). Interested reader could retrieve further information on the most known but discussed rankings: The *Times Higher Education World University Rankings* (Baty, 2011), the Scimago Institutions Ranking which includes also other research institution in addition to universities (cf. their web site: www.scimagoir.com), the Academic Ranking of World Universities (ARWU; www.arwu.org), commonly known as the Shanghai ranking (Liu and Cheng, 2005) and the Leiden Ranking based on bibliometrics indicators of publication output,

citation impact, and scientific collaboration (Waltman et al., 2012). We deal hereafter with another kind of indicators, which address the usage degree of the cyberspaces developed by institutions.

In France, for each of the policy objectives in the *Loi organique pour la loi de finances* (LOLF), the government of France set one or several indicators to monitor the progress and attainment of these objectives. In Table 4, (Martin and Sauvageot, 2011, 38) details the matching indicators with objectives in this country. Item 12, within the objective to “optimize the management of higher education institutions, including the management of facilities” specifies the indicator “Utilization rate of facilities”.

In the French higher education, many digital services (email, intranet, forums, Web site publishing, diaries, school-related services, documentation services, budget management and accounting, online courses, and others) are now available to students, teachers and administrative staff. They form part a facilities provided by the institutions.

Historically, the Ministry of National Education, Higher Education and Research has decided to promote the deployment of digital services through several actions, one of these is the digital universities in the region (*Université Numérique en Région - UNR*) that has to meet strategic objectives:

1. Offer of a bunch of digital services to the university community (students, teachers, administrative staff and researchers)
2. Take into account access to the infrastructure for all students (collective and individual equipment, networks, etc.)
3. Offer support for digital uses.

Today, the digital mission for higher education (*Mission Numérique pour l'Enseignement Supérieur - MINES*), within the French Ministry of Higher Education, monitors and is the national coordination of UNR. Currently 17 UNR fully cover the national territory. Since there, we have identified through a survey (Reymond and Dib, 2008) a range of facilities deployed as a variety of digital services in a very heterogeneous way. Hence this is a characteristic of the cyberspaces at the national level. The maturity of these portals settlement is reached, however.

The main digital services deployed within UNRs revolve mainly around registrar processes, e-education, collaborative tools and communication, library resources, university life and relationships with companies. But a lot of other services can be deployed independently by institutions. Thus, according to the latest estimations, 98% of French students have access to a bunch of digital services.

In order to provide a quality service to the end user, the MINES wishes to provide to the UNR a device for automatic build usage indicators of the digital services deployed. The immediate challenge using those indicators is to be able to evolve and adapt these digital services, the "virtual" campus, helped by the factual usage data that are to be made. If each digital service can produce its own data traces of activity, the data are strongly related to the application technology service, the data is costly and time-consuming to analyse, and generally not interoperable: using simple data trace, it is very difficult, for instance to analyse the users' navigation between services). Furthermore, the user IDs coding form may be different, and a comparison of the traces (logs) on services similar but that use different technology is not immediate and sometimes impossible. Other well-known limitations arise when it comes to treating the very substantial volume often remarked (Honest et al., 2012) of these log files. Finally, as we could get usage data on a digital service, say x% for a category of users, how do one know if x% is a good rate or not?

The main problem addressed here, is to demonstrate how the tool AGIMUS built in this context addresses as well technical issues but also, appears as collaborative tool by aggregating national usage data, to provide at the upper level a usage knowledge national system. We will discuss how this knowledge base could help policy makers in taking decisions taking account the AGIMUS national reference data for service consumption levels. The needs for interoperable infrastructure come as evident and at functional level, generic indicators must be sufficiently explicit to serve as an instrument for monitoring the functioning of the system.

The data collection level in our work includes these works in the web usage mining field, however, digital services are accessible via authentication (users are known and declared into the information system), and we have to produce indicators at the national scale and not only on a few servers that is to ensure the need for coherence indicators. Furthermore, usual analyse of web data usage is self-referred (Jansen, 2009) as performance indicators created are used historically for improvement of provided services. We propose here another way for analysing the indicators taking advantage of the national hierarchical construction to determine reference levels of usages of services.

Within this disciplinary context, a solution to monitor cyberspace and to describe the behaviour of consumers (students, teachers, researchers... in our context) has been developed. The solution is

extended also to provide national knowledge on the usage to construct a reference level to be targeted by cyberspace governance.

2. APPLICATION DE GESTION DES INDICATEURS DE MESURE DES UTILISATIONS DE SERVICE (AGIMUS)

Following a call for tenders launched in October 2009, the application was developed by a society in respect to the constraints presented before (Reymond and Dib, 2009). The application is called AGIMUS.

It offers for each university the opportunity to build its own indicators measuring usage of the audited data services provided. Finally, the same application is used to produce aggregations and build trees of data collectors. The trees settled up can be as varied as the landscape of the ES (institutes, engineering schools, university, UNR, etc. see Figure 1 for the main intended tree construction) and the author publications for technical precision on the architecture.

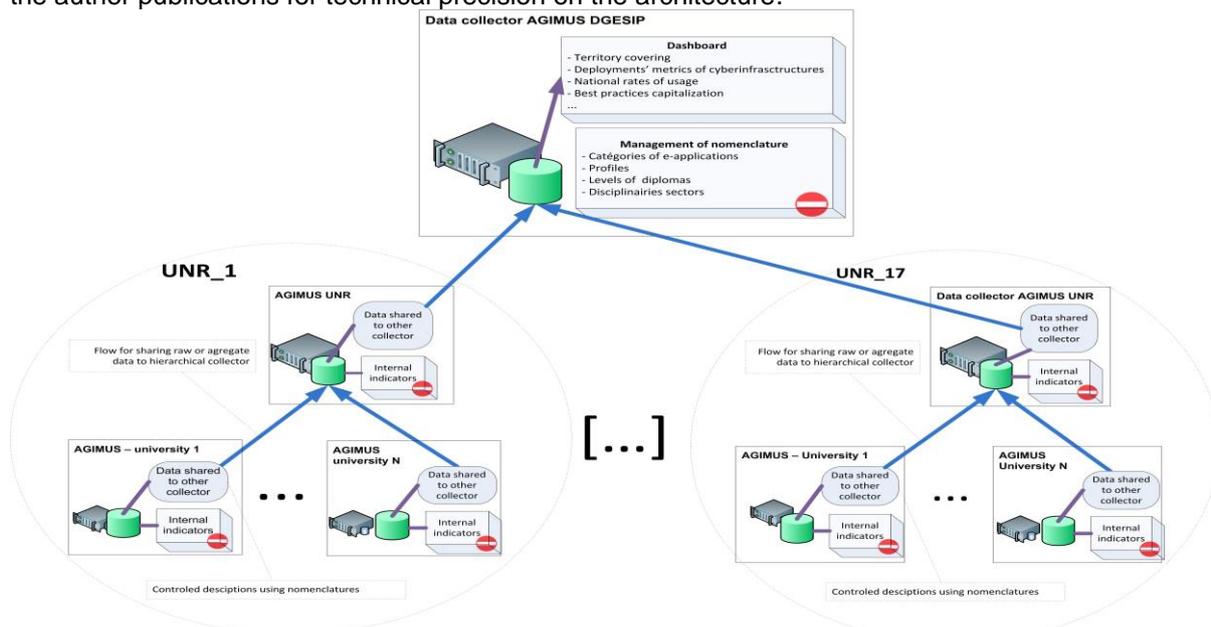


Figure 1: overall recursive implantation process within the 17 UNR, data flow and nomenclature for data aggregation process. Each level provides internal dashboard and feed upper level with normalized usage data.

3. AGIMUS INDICATORS BUNDLE

As installed and the first logs processed, AGIMUS provides a bunch of preconfigured indicators. These initial indicators are relatively simple. We just describe and comment some of them and invite the interested reader to consult the annex of this article and Reymond and Dib (2010b) for a more complete description. The preconfigured set is split into three categories according to the purpose of AGIMUS use: monitoring and maintenance indicators, management and operational indicators specific to the collection system. AGIMUS provides also an interface to create internal indicator more specifics using the SQL language.

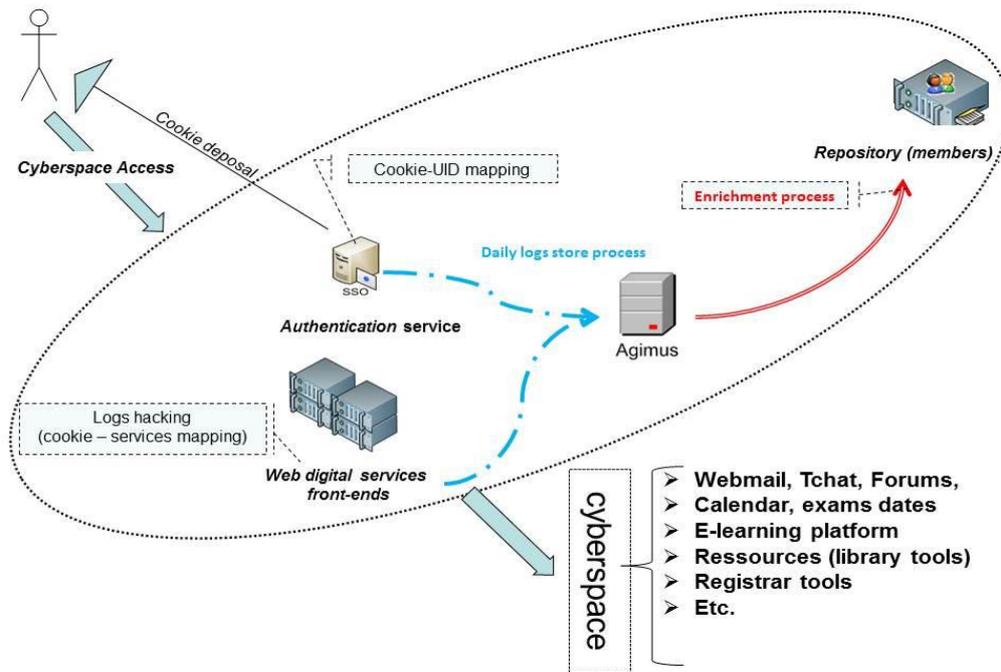


Figure 2: AGIMUS implantation into the information system. Transparent for the users, the data collector system operates in front of the cyberspace.

3.1 AGIMUS' basic indicators

We provide the complete description of predefined indicators coming within Agimus package in Annex 1. We remind hereafter the objective of such indicators combining the cyberspace level (level N) and the view on multiple cyberspaces (Level N+1).

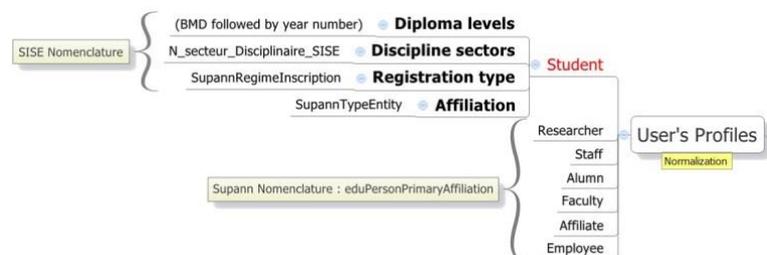


Figure 3: Users dimensions in two levels mode. A generic anonymous profile and a sub-decomposition of the student profile characterized using national nomenclatures.

3.1.1 Monitoring indicators

Monitoring indicators provide information on the operational level and daily use. They are useful for planning updated applications, modifications to allow the selection of off-peak periods to interfere as little as possible the user's activity. These indicators detail the comparative degree of actual cyberspace use at level N. They are used to estimate a priori the degree of use of each service. This range covers indicators e.g. the number of connections, unique users daily and the number of operational services in the cyberspace.

3.1.2 Governance indicators

Governance indicators describe the services offered and service usage (by counting access), the average behaviour of users is expressed in session duration, and frequency of these uses. They are produced at an AGIMUS instance or aggregated to provide information on the actual use of services in comparable way. Institutions have also access to rates of connection counts and complete the analysis of these usages.

Of course, each of the indicators mentioned above can be broken down into the categories of people, and for the student population, according to the dimensions that characterize them (see Figure 3).

3.1.3 Operating Indicators

These indicators are intended to assist in Agimus implementation and validation of the audit procedure of the cyberspace. N +1 level is reconstructed also by summative aggregates. Those indicators monitors the population counts, the different URL (i.e. services) tracked, but also the patterns detected as a potential new service to track.

For more details on these indicators and the method associated for piloting cyberspace deployment, the reader is referred to (Reymond and Dib, 2010a, 2010b). We focus hereafter on new composite indicators, not yet implemented.

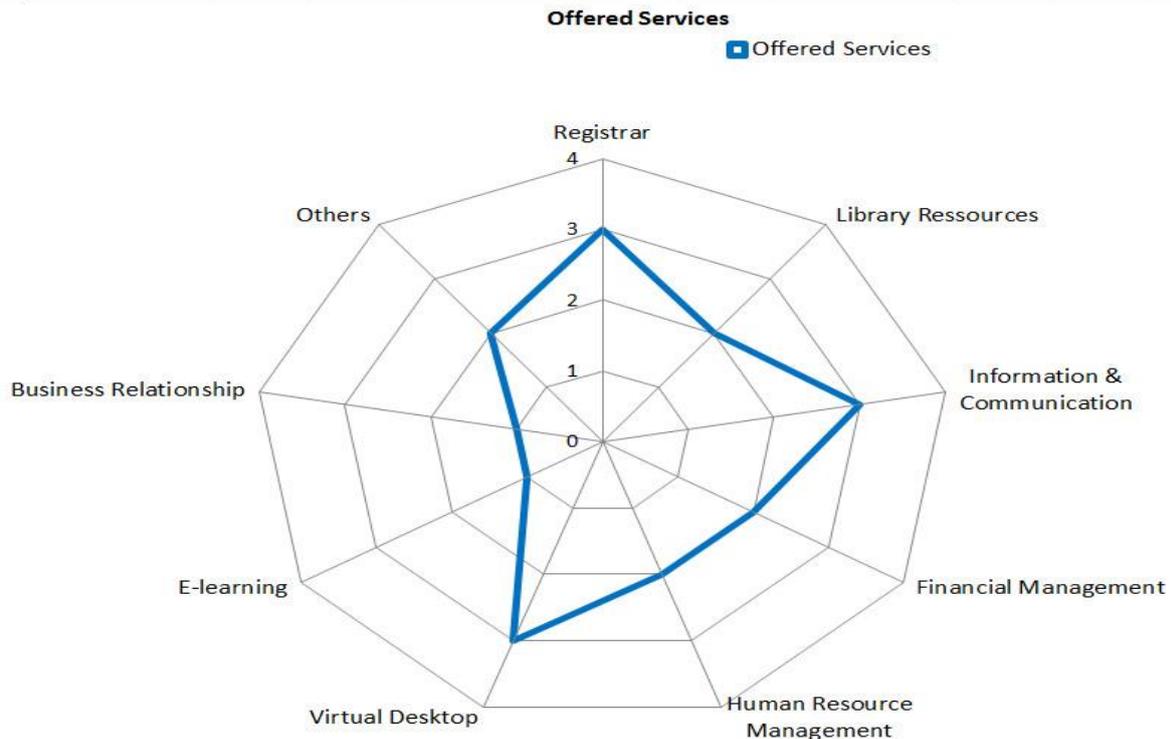


Figure 4: the cyberspace richness expressed in term of a functional coverture in a range category and the number of digital services in each category.

3.2 Composite indicators

At the governance level, a more synthetic view is expected to be proposed by AGIMUS (we plan it for next development patch). This view is composed by a special bunch of indicators that will provide a bi annual factual description of the cyberspace. At the first level of collect, this dashboard will describe the cyberspace richness and the usage degree. For the several aggregates levels, leading applications in usage degree or most consuming disciplines will compose also the dashboard. We describe hereafter such indicators.

3.2.1 Cyberspace richness

We define it as the number of offered digital services within the functional categories developed to mask different kinds of cyberspace technical architectures (Reymond & Dib, 2010a).

Figure 4 express the cyberspace range in term of digital services categories (Registrar, Library and resources, Information communication, etc.) where are classified in the AGIMUS configuring step the several services. This indicator expresses the coverture of the cyberspace offered and describes how many services are deployed in each category. In the example, we see that three services in the Registrar category are offered, while one service only in the e-learning category is provided, etc.

In order to appreciate also the degree of use of the cyberspace, we mix with the cyberspace richness the most used services using a threshold to make present in the graphic the number of services that are effectively used by a sufficient rate of the whole population. The threshold (arbitrary fixed in the

fictive example in Figure 5) is applied to display the services used by more than 40% of the population. Thus, in the example above, we can see that the application range is covered by the cyberspace, the whole range seem to be used by an honourable rate of the population except within the Human Resource Management category. In the Information and communication category (this category encompasses webmail, chat, forums and blogs services) three digital services are offered. Two of these are used by more than 40% of the population. Such synthetic view may express at a time the cyberspace coverture but also its global degree of use.

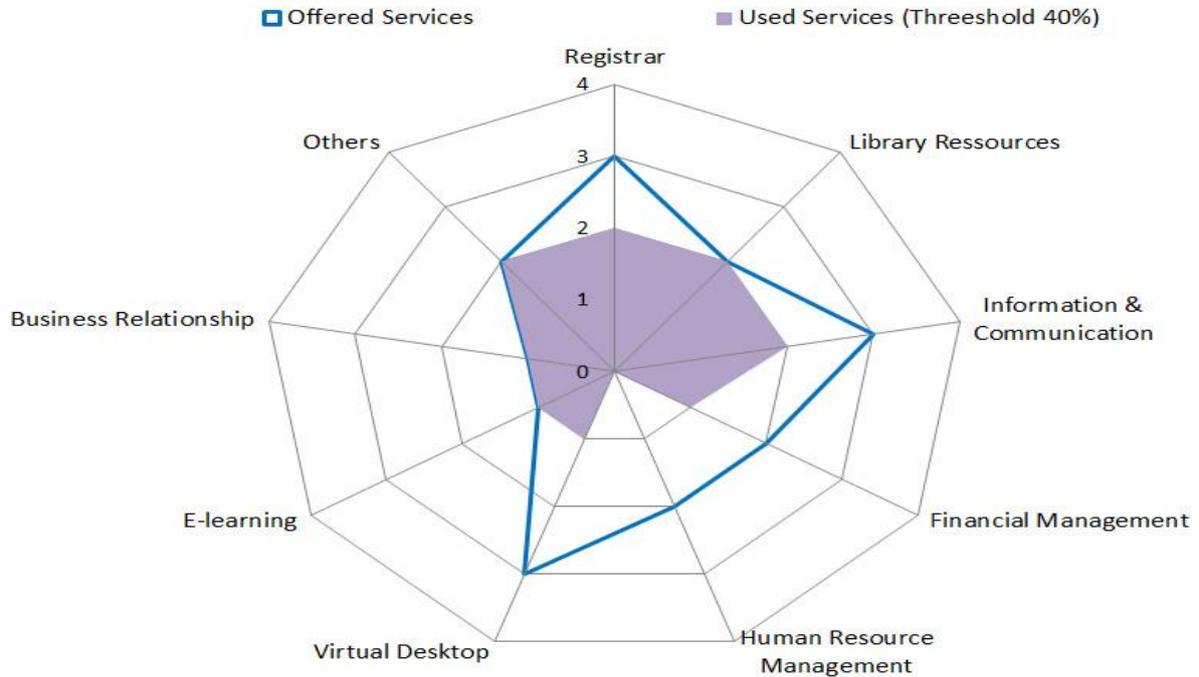


Figure 5: Cyberspace richness coupled with used services displayed using a threshold cut-off.

3.2.2 The leading exhibits indicators

A second kind of synthetic views will be included in AGIMUS in order to highlight the cyberspace's most used applications or most consumers' profiles.

For example, Figure 6 displays an extraction of the cyberspace services for a given utilization threshold rate for the entire population. The three main services appear in the fictive example. This indicator highlights the most used services for which a particular attention must be paid (availability, reliability). In-depth analyse must integrate with this indicator the frequency of use, but also internal (to the university) differences for the several kinds of population for instance.

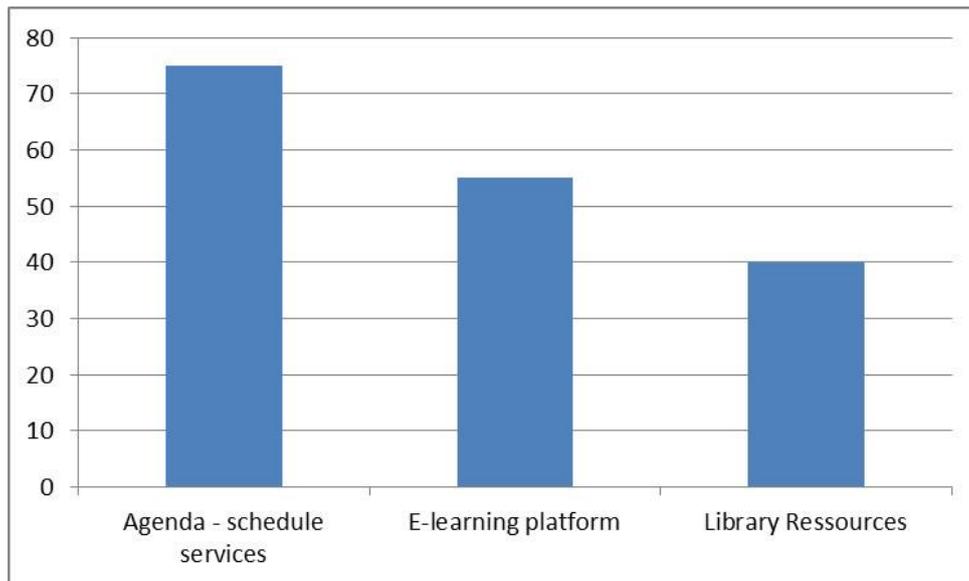


Figure 6: the leading digital services (fictive) appear with their respective usages rates (in percentage of the whole population).

Figure 7 shows the distribution of cyberspace usage per discipline in a multidisciplinary environment. This indicator allows examining further the interests of the various services offered to consumers under the disciplines. Less interested (in appearance, here in this fictive diagram Languages and Law) discipline should initiate targeted information campaigns, special support or in-depth studies to understand better the poor attraction to cyberspace they seem to have. For the biggest consumers' (here Science and Economy), such information should initiate in-depth study to understand which new services would be needed or how can evolve the actual cyberspace. As disciplines are generally grouped in the same department this information offers a good way to show where to start for such qualitative and expensive studies. As AGIMUS proposes to customize the several indicators, other dimensions within the information system could be more pertinent to use in particular situations. As the previous indicators focuses in inner situation, the AGIMUS aggregating process allow also building up comparative indicators that may help in evaluating the cyberspace. Before entering, the national view in the knowledge usage database projected, the combined form of the previous indicators, entering a light in-depth overview, may provide composite indicators as presented in Figure 8.

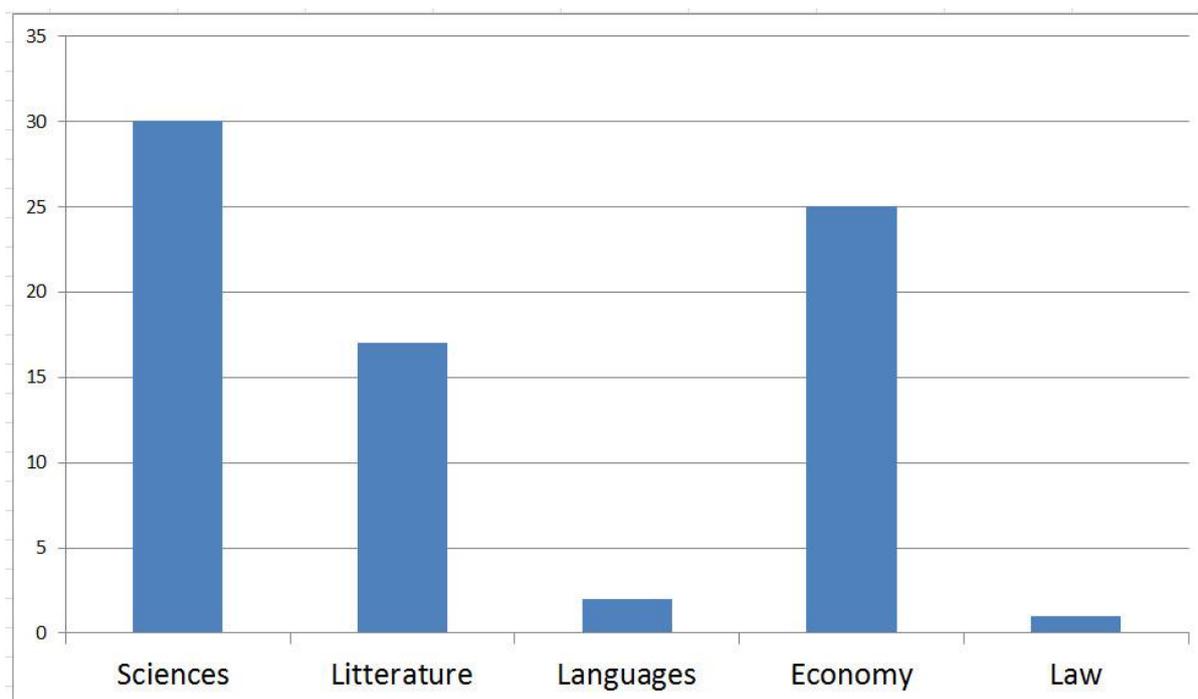


Figure 7: Fictive comparison of discipline consumption of services. The rate of usage in y-axis, and the disciplines present in the university in the x-axis.

This indicator shows in a comparative display mode within several UNR the rate of use of applications (here the webmail). The rate of population (in y-axis) is displayed for each year of study level (LMD followed by the number of years).

In addition to the comparative aspect of highlighting the tools adopted by most people, this view could also highlight best practices information, support, and training tools that are provided besides the cyber infrastructure. As this information (how support is offered, how communication and accompaniment process are deployed besides the cyberspace) is not directly present, this could be a starting point for discussing best practices between the several providers.

4. NATIONAL KNOWLEDGE BASE AS REFERENCE STATISTICS

Beyond informative indicators that can feed the creation of usage knowledge database at the national scale such as the most widely deployed applications (Figure 8), or the most commonly services used by students, the main interest would be to establish useful baselines to governance of digital services. As previously announced, as soon as AGIMUS delivers usage indicators on services deployed, actual use of those indicators is in self-referred mode (Reymond and Dib, 2010b). That is actually the unique way to perform governance using the historical evolution of rates as the sole informational source. We state that this is due to the fact that we do not know what should be the "good" level of usage of a digital service (of course, one could target also a 100% rate, but a reference median level would inform where we are). Many questions arise in complement to this statement on what can be expected:

- What is the average level of connection to a digital service?
- What is the average frequency of use?

We state that providing this information will allow piloting the deployment of the cyberspace by knowing what should be targeted in term of usage. Interpretation of local indicators may also result easier and not only self-relative.

To complement this, reference statistics should be also established for the different population categories segmented by level of study and disciplines as well. As, inner statistics can be biased by many social parameters, national level statics may inform on global trends in usage behaviour of students. This would facilitate furthermore the interpretations:

- Should there be differences between disciplines?
- Should there be differences in the level of studies?

Thanks to the basic functions of AGIMUS and its aggregative process, all the necessary data is gathered through the different collectors. The establishment of this collective knowledge of the behaviour of students (that is the majority of the client population to the cyberspace), it will be possible to initiate a referee piloting process for the digital services and is straightforward connected to educational ICT system usage.

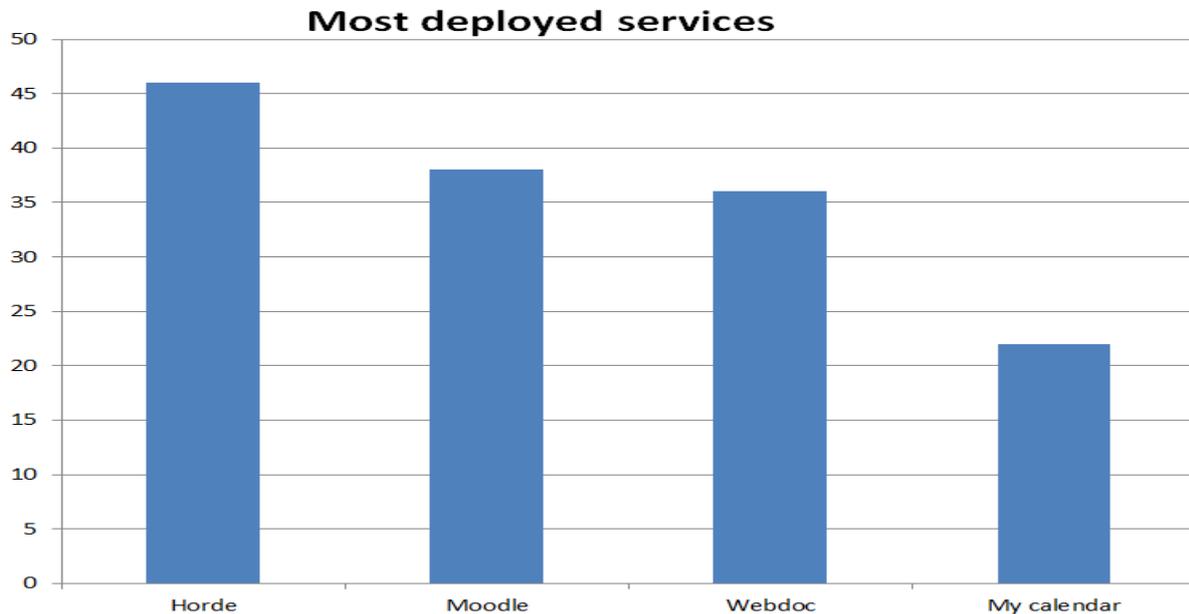


Figure 8: Fictive view (at the time of writing) on most deployed services in the national cyberspace using AGIMUS for monitoring usage.

5. CONCLUSION

The method of production of indicators associated with a guide method to pilot the cyberspace underlying this article is underpinned by research currently very active at the international level (Harley 2007; 2008; Nicolas & Rowlands 2010). Technical issues traditional in the web analytics domain (Castellano et al., 2013) are dodged by the collecting process of AGIMUS and the consideration of access usage only.

AGIMUS is developed under the free software CECILL license, and is adaptable to a variety of architecture as a non-intrusive way to audit access to web services. The authenticated context is used to group usage indicators by generic well-known groups in the academic context (such as level of diploma or disciplines). Agimus is actually in version 1.5 and the deployment into the French universities cyberspaces is in process. Interoperability of data is ensured by standardization carried out by AGIMUS parameterization at the base of the collection process thanks to national referential (*SISE*, *SupAnn*). The reliability of measurements is guaranteed by the implementation of AGIMUS by the holders of the information on local specificities (Reymond and Dib, 2009, 2010a), the managers of the cyberspace that can choose if yes or not, access data should be aggregated for such or other service. This point avoids inconsistency frequent in widespread indicators.

As the deployment of digital service isn't straightforward (Gerbod and Paquet, 2001), AGIMUS offers a basic and standard dashboard to state the functional range of the cyberspace, monitors its activity and state its global usage rate. This first step-indicators, allow a self-referee piloting process, in a performativity mode for each services provided. The granularity of the indicators is linked on the natural groupings of academic profiles, and the standardized nomenclature for their description offers the possibility to refine this description and opens to in-depth analysis. Observing local singularities in cyberspaces usages opens the way to targeted qualitative survey at low cost but more informative on usage, intensions and necessities of users.

As the deployment of digital services is described as a must have for universities, those indicators are useful for policy makers in order to choose the digital tools, to appreciate their usefulness but also to begin process of accompaniment for users in a targeted and specific way. This help entering the local quality assessment of digital services deployed.

As the AGIMUS standardized data open the way to compare different cyberspaces (Reymond and Dib, 2010b), we state also that this data may also feed a national reference database. Collecting and

aggregating data at the national scale opens the way to build up some reference statistics that would be useful to start piloting process according to the median degree of usage that would provide this knowledge base. Only the widespread adoption of this solution within the academic institutions will allow producing reliable data on student's behaviour.

Agimus, associated with this national repository, opens up several ways to the implementation of functional additions, to improve ergonomics of service in line with actual and potential users, but also to make experiments deploying new applications. Exploiting Agimus aims in co building indicators in the cyberspace piloting process allow sharing costs by institution. As cyberspace are delicate and difficult to set (Gerbod and Paquet, 2001) but useful for universities (Jacquinot and Ficher, 2008); Agimus comes as a tools not only to satisfy internal indicator producing wider views as expected for Virtual Learning Environment (Dyson and Baretto-Campello, 2003), but also it appears as a distributed tool to co-construct a knowledge base on user's consumption in order to keep virtual campuses (Brown et al., 2010) as up to date, attractive and useful.

Further research, as soon as the deployment will provide data will address trying to dress up behaviour profiles, comparing global cyberspace behaviour and e-learning skills (Reymond et al., 2012). National level is expected to alimnt statistics for the observation of usages and digital services consumption by profiles, exhibit trends and help universities in the success of their cyberspace providing objectives.

6. ACKNOWLEDGMENTS

The author would like to thanks the many contributors to this development specially, Sandrine Twardy (Université de Toulon), Nicolas CAN (Université de Lille 1) and Julien MARCHAL (Université de Lorraine) for their precious technical advises and support.

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ANNEX 1: AGIMUS PREDEFINED INDICATORS

AGIMUS comes with already settled basic indicators. They remain into three categories according to their usage objectives, conforming to the educational hierarchy level as described by Jacquinet and Fischer (2008, 20-21): monitoring and maintenance indicators, management indicators and operating indicators. We describe them hereafter inviting the reader to keep in mind the possible variations in the several users' characteristics presented in part III.2, but also with home settled dimensions allowed by free space in Agimus database.

Monitoring indicators provide information about the daily operational services and their degree of use. They are expected to be used in a management plan: planning an update of applications, allowing low user incident modifications in choosing off-peak periods, etc. AGIMUS acts at this level as many other systems offering the centralization of activity logs of all deployed digital services. AGIMUS also allows refining the indicators produced by splitting activity information on user's categories. At the N+1 level, these indicators give a detailed comparative view of usage in institutions at N level. They can be used to estimate the degree of usage of each service and compare them. In the upper levels, the analysis should generate a best-practice perspective (for instance regional), and exchange between managers methods or products that seems to be best suited for students and staff.

Table 1: settled monitoring indicators in AGIMUS

E-service operator (N level)	Services aggregate (N+1)
Number of uses	Number of uses
Effective daily users	Effective daily users
Number of operational services	

In table 2, we present the governance indicators that are used to describe the services and categories of service in order to outline the average behaviour of the users. Behaviour is simply expressed in terms of the duration of a session and the frequency of connection. Whether they are produced for a single institution or, by aggregation, for several institutions these indicators provide information about the **effective use** of services. Locally, the institution can use the raw connection rates to complete the analysis of usages and split it into inner group's differences.

Table 2: settled governance indicators in AGIMUS

Digital service operator (level N)	Aggregated level (N+1) Category view
Digital service covering	Categorized digital service covering
Average session duration	Average session duration
Average frequency of use	Average frequency of use
Raw connecting rates	Raw connecting rates
Types of browsers	

Table 3 describes the operating indicators specific to the AGIMUS device itself. These indicators are designed to assist in its implementation and the validation of the audit process of digital services. At N+1 level the data is reconstructed by a summative aggregation. In this indicator, appears the population numbering that is used to calculate rates for all indicators of penetration estimation within the population. The numberings here are as important as the dimensions settled in the database (number of students for each level of study + number of student for each discipline + number of students for each registrar mode and so on).

Table 3: AGIMUS settled operating Indicators

Indicators	Definition
URL detected	Allows the identification of new applications
Digital audited services	List of web applications declared and audited
Population numbering	The number of the different population is used when calculating rates.