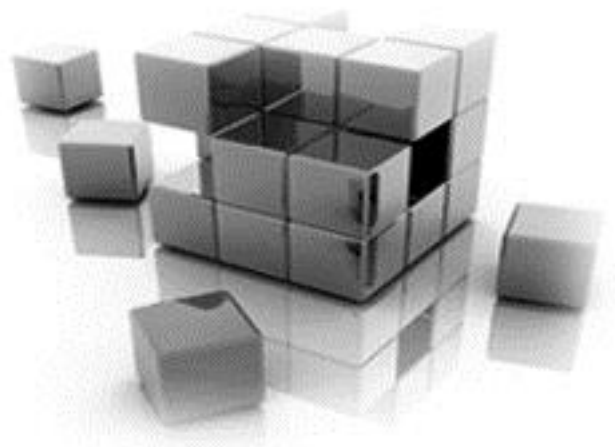# Study:
Digital Library
System Architecture

Executive Summary, November 29, 2013

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1. Introduction

Objectives of the study

The Flemish digital public library is the result of collaborative work between governmental organisations at the municipal, provincial, Brussels and Flemish levels. The cost-effective development of a consistent user experience for the digital library of the future requires to consolidate future plans into a common vision and agenda. This study[1] has been conducted between January and August, 2013, in order to draw up a blueprint for the future architecture of the digital library. This architecture takes into account the ever-increasing need for digital services and collections.
The purpose of the blueprint is to provide a framework for the collaboration between the different players in the coming years.
The study's sponsors also intend to use its results internationally in order to collaborate with various stakeholders: public and private players, suppliers and users of technical solutions.

Context of the "digital library"

The digital library is a collective name for all of a library's products, processes and services that are digital and/or automated. The digital library spans across the Flemish public library network. Indeed, even if public libraries are managed by municipalities (i.e. local governments), it is necessary to elaborate a comprehensive package of digital library services that goes beyond the local municipality's boundaries. A cost-effective

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[1] See final report, chapter 1 'Introduction' voor a detailed description of the study's objectives, methods and approach.

management of the digital library will require rationalising the large number of ICT systems currently used to deliver basic library services.

Transition to a business-critical digital library

In the recent years, the various levels of government (municipalities, provinces, region...) have made investments in order to automate the public libraries' services and connect them to the Internet, following the expectations of library patrons. Nevertheless, the core of the libraries' networks and collections is not yet "digital". For all automated services, an offline alternative is still available: on-site renewal and reservation as an alternative to online renewal and reservation, front-desk personnel as an alternative to lending terminals, local PCs or paper-based lending solutions in case of a network breakdown... Most library services are still based on the circulation of physical resources in physical places. The transition to a digital library with additional full-fledged online self-services is a challenge that public libraries need to address if they want to play a meaningful role in the digital space. Citizens are nowadays online 24/7 and expect to access their library services online. The ICT systems that will support such a full-fledged digital library will soon become business-critical, and transitioning to a business-critical digital library requires a better underlying infrastructure based on the principles of systems integration and rationalisation. The way we deal with media, culture and information today is fundamentally different from 15 years ago. The Internet has had a worldwide impact on most sectors, including the media, information and cultural sectors. Libraries are at the crossroads of these sectors and are therefore under high pressure to reinvent their service portfolio. Despite the major impact of the web and of the general availability of information, the physical building of the public library continues to play an important role. The further expansion of the physical library can go hand in hand with the further development of the digital library. Nevertheless, it is not excluded that for a fraction of library patrons, library services will be delivered entirely online and they will never visit the library building. If the industry does not embrace this digital service model, the library will cease to exist for an ever-increasing part of the population. The share of paid content on the web is increasing every day. If

libraries are unable to offer sufficient access to this online content, their collections will not reflect the whole supply and the information gap will likely increase.

The library sector faces major challenges. In the digital age, libraries need to largely reinvent themselves in order to maintain their social relevance and value. Moreover, the current technical and organisational models of the digital library are under high pressure. They are mostly still based on physical lending processes.

2. Conditions for a business-critical digital library

In order to build a sustainable digital library, the study identifies several areas in which work will be necessary in the coming years. In order to start working on these "work areas", it is necessary to start from the following basic conditions described below.

Appropriate ICT organisation and governance

For the good execution of the digital library work areas, it is important to establish a global ICT governance that can take determine how the various IT responsibilities are shared and distributed.

Partners

There are currently 6 categories of stakeholders that are each responsible for specific components of the systems architecture: local libraries, municipalities, provinces and the the Flemish community commission in Brussels, Bibnet (Flemish government), library users (citizens) and external partners. The external partners are private companies or public organisations with which the library sector collaborates in the context of specific services or collections.

The ICT systems of those players are run at 5 levels: local/municipal (e.g. secure public PCs), provincial/Brussels (e.g. Library system with lending

module), Flemish (e.g. central catalogue), national (e.g. electronic identity card), international (e.g. social media platforms).

The Flemish public libraries currently work with 64 different types of ICT systems (e.g. Vubis, Brocade, Aleph, Aquabrowser, C-OPT, Iguana, Timetracs…). Each system is a component of the overall solution: the digital library[2].

Consistency, cohesion, shared (technical) strategy

The current (fragmented) organisational model of the digital library is reaching its limits, and will eventually crash. A common blueprint for the future system's architecture requires an appropriate decision-making structure that will monitor the proper execution of each work area and guarantee the consistency and the cohesion of the strategy as well as of its implementation. In all phases, standards must be established. The system's architecture must be under the responsibility of an IT architect in charge of monitoring consistency. The establishment of teams with clearly defined responsibilities is at least as important as the development a well thought-out system architecture.

Common organisation structure

A business-critical digital library requires that the solution be operational at all times. Within the current systems' architecture, the failure of a single system can cause a "domino" effect on other systems and result in large-scale disruption of services. Even with a robust system architecture, the business-critical nature of the digital library requires constant support in the form of helpdesks, contact and communication tools for the public library and its staff. Organising these support teams and tools requires a structured cooperation between all parties.

Flexibility

The organisational structure, the policy makers involved, the collaborators, the project management and the infrastructure of the digital library must all

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[2] See final report chapter 3.4 'AS-IS ICT applications' for the analysis of the complex ICT lanscape or the digital library.

be able to deal with constant change. The digital landscape's fast evolution requires a shared vision and a decision framework that allow for quick reactions. An organisation that is unable to respond to changes with enough flexibility runs the risk of perpetually having to catch up with backlogs. Systems that are unable to follow change will soon become an inhibiting factor. This is currently the case for systems that are insufficiently open and modular and for which every (small) change generates a (large) cost.

Financing

The work areas identified throughout the study require investments in terms of time, expertise, personnel and financial means. Investments in every work area seek to improve the digital library so that it makes the most efficient use of available resources over time. In addition to the development of new innovative online services and collections, the rationalisation and optimisation of the current systems, projects, organisations and infrastructure are of the utmost importance. Rationalisation and optimisation create the conditions that enable the additional investments that are required to build a future-proof full-fledged digital library.

Marketing the digital library

The digital library needs an integrated marketing plan with a shared vision across all stakeholders.

A library with various service touchpoints

The marketing of the digital library cannot be separated from the overall service portfolio of the public library. The web is one of the "touchpoints" or contact points where citizens can interact with the library. The physical library in the city is another touchpoint that remains very important for the visibility of library services for a large number of citizens. However, public libraries more than ever need an online identity in addition to the local on-site services. It is advised to align the online identity with the physical one as seamlessly as possible. For instance, the lending of e-books can be an online service, but it does not preclude from organising activities within the library walls around these online collections. Conversely, it is also appropriate to

offer online collections that follow the collection management policies of the physical library. The complementarity of an online and offline space is a differentiator against purely online shops. Stores such as Apple or Ikea demonstrate how online and offline services and presentation can be adjusted and aligned. The pursuit of recognition and building a brand with a clear image are key elements in how citizens will come to know and experience the library as a customer-oriented service.

Online marketing

The visibility of online services requires specific marketing methods and online actions for which there is currently too little knowledge in the public library sector. The extent to which the library and its collections are visible through external search environments such as Google is a critical factor in the success of a digital library. Applying online marketing techniques (e.g. Search Engine Optimisation – a set of activities designed to make a webpage rank high in the output of a search engine) is a necessary step towards building the digital library and making it visible and known. The various stakeholders need to share a common vision and strategy in order to achieve this goal.

User Experience

The user experience is the degree to which a customer can intuitively use all of a service's features in a pleasant way so that they become a returning customer. End users do not think in terms of administrative boundaries, or specific touchpoints or channel. For a given task, the ease of use prevails. The ideal customer service allows customers to choose which method works best for their specific context. A model where the customer and their user experience are central is the best form of marketing, and a provides method to build "self-selling" services. For the further development of the digital library, it is important that a shared vision be developed with user experience as a guiding principle. It is important to dare to "think through" to full-fledged digital services, e.g. offering not only access to digital collections, but also online electronic payment services.

3. Work Areas

The current system architecture of Flemish public libraries is described in detail in the "final report" (AS-IS chapter[3]). A future system architecture has also been described (TO-BE chapter[4]). To evolve from the current situation to the target future sustainable system architecture, 7 areas have been identified in which work will be needed in the coming years. In the final report, the work areas have been placed on a timeline. The motivation and initiatives per work area are listed and briefly explained in this summary. For a correct realisation of the work areas, the three following basic principles should be applied:

- **Openness**
  Ensure that data, information, systems and features can be flexibly linked to each other through open environments.

- **Reusability**
  Ensure that data, information, systems and features are reusable.

- **Cost efficiency**
  Seek out economies of scale and cost efficiency.

Innovation versus extension and consolidation

The work areas are all, by their nature, long-term projects that can be divided into several initiatives and work packages. For each work area, work is necessary on one hand to *rationalise and optimise current processes and systems*, and on the other hand to *innovate*, where innovation is not done for its own sake but meets the needs of a business-critical digital library. The success of each work area will depend on the performance and the quality of others. It is therefore recommended to monitor the consistency of the work areas as well as the correct execution of them.

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[3] See final report: Current system architecture of Flemish public libraries (AS-IS), chapter 3
[4] See final report: The Future system architecture of Flemish public libraries (TO-BE), chapter 5

Work Area 1: Business intelligence (BI)

Libraries need better tools for the analysis and reporting of their transactions and activities. The library's management and many other stakeholders need clear insights based on high-quality data in order to help take many decisions. During the study, it was noted that libraries lack many tools for their strategic and operational business analysis and reporting (IT term: business intelligence). Today, a need for statistics or specific information is fulfilled by ad-hoc data exports from different systems, compiled and processed manually in order to provide the desired insight.

Initiatives
1. Setting up of a global data warehouse
2. Setting up of Key Performance Indicators (KPIs)
3. Data facilities per type of stakeholder (dashboards)

1. General data warehouse

Today, the libraries' data is spread across many different systems. A special project is required to build a global view of all aspects of the each library's service usage. Data can be collected and brought together in a data warehouse.

The main feature of a general business intelligence system is the collection of datasets that can give a comprehensive picture of, for instance, how a specific user group makes use of a given library service (online searches, circulation, visits to the physical library, online renewals…). Those reports are important to make informed decisions. During the study, few of the tools and processes encountered were aimed at automatically collecting data from different systems in order to present consolidated views. In a digital service model, the contact with the user goes through computers and graphical user interfaces. Since online services involve less human interaction, if there is no

system to automatically measure how the library services are used, libraries can lose insight on how their services are experienced by the patrons.

2. Key Performance Indicators (KPIs)

In order to measure the success of library services, it is necessary to define indicators within the data warehouse that can be used to draw comparisons and identify trends and evolutions. Today, indicators exist to monitor the evolution in the use of the physical library services. However, an overall view, which could help for instance to understand the link between the use of a particular collection and the corresponding online services, is still missing. As soon as KPIs are defined, it will be easier to determine which data needs to flow from operational systems to the data warehouse.

3. Dashboards

The collected data and the KPIs provide no insights on their own. They need to be translated into a digital environment that can be accessible at all times by various user groups through dashboards specifically built to help them in their work or activities. For instance, someone who is responsible for collection development can see what part of the collection works well for a specific audience; employees of the Bibliographic centre (central cataloguing team) can see which ordered publications have insufficient meta-data; a patron can see their reading history regardless of the underlying circulation system... Personalised dashboards provide a means to respond to trends and changes in a flexible and sustainable way.

Work Area 2: IT maturity

Throughout the sector, the IT maturity of employees and the quality of the local IT infrastructure require particular attention. They play an important part in the image and functioning of the digital library.

Initiatives
1. Drawing up of a general IT Organisation Chart
2. Development of a shared project management platform
3. Establishment of a shared collaborative knowledge system

1. A local and layered IT-Organisation

Independently of the infrastructure, the digital library needs collaborators who possess the sufficient IT maturity and skills to manage the performance of services and systems. The flexibility needed to respond to changes requires that these employees must work in teams, with clear roles and responsibilities assigned. This doesn't mean that libraries need to be able to perform all IT tasks, but rather that collaborators in the library are well informed about which expertise is needed and when, as a part of their duty to guarantee services and ensure system performance. Also when the library partly or fully collaborates with the municipality's ICT services on the library's ICT infrastructure, there needs to be someone within the library organisation who can manage and negotiate the quality of the services provided. The library must also be able to evaluate the adequacy of the municipality's ICT services with respect to the minimal ICT requirements related to running a digital library.

During the study it could be observed that there are neither supervision nor screening processes aimed at building or maintaining the library employees' ICT skills. Often, the success of locally organised digital library services depends on the employees' enthusiasm and/or the fortuitous presence of specific knowledge among them.

In order to develop the digital library, it is necessary to document the complete layered IT organisation with the corresponding responsibilities in a general organisational chart. Cooperation with the municipalities is essential, but this remains problematic today because of the great diversity in IT-maturity across municipalities.

2. Shared project management system

A business-critical IT environment requires constant attention to project management. Given the layered nature of the library network, the responsibilities in carrying out projects can be distributed over various organisations. Therefore it would be interesting to use a shared environment for project follow-up (e.g. milestones, responsibilities, required personnel, financial resources required, rollout of a new service...). Project management requires keeping all stakeholders informed and continually manage the related communication. There is a wide range of ready-to-use project management systems on the market that can support the kind of project management required to build the digital library.

3. Shared & collaborative knowledge management system

In addition to the communication about currently running systems, it is necessary to share knowledge in the context of innovations or system extensions. For instance, the specifications of a new hardware or software system, terms and conditions for mission-critical production systems, Service Level Agreements (SLAs)... This information is currently not easily available or shared, and is often built from scratch for each project and for each partner. Sometimes the specifications are incomplete due to lack of knowledge about the needs or to the insufficient fulfilling of required formalities. The suppliers tend to take advantage of this situation when problems emerge, as the client might discover too late that there is no agreement on paper. Such situations can be avoided by increasing the sharing of the key documents that are necessary to the management of IT solutions.

Work Area 3: Web presentation

The web is an important channel for the digital library. More and more often, the web is the first place where the public meets the library. The library's website is a communication hub for the library's service portfolio.

Initiatives
1. Development of the public library's service portfolio
2. Drafting of library website guidelines
3. Development of a locally reusable library website template
4. Development of pluggable services and common web tools

1. Public library service portfolio

What is the range of services offered by the library inside and outside the library, offline and online, within the library walls or in other places in the city? The offer increasingly varies from one library to the next. Local libraries set different priorities in their offerings and partnerships. It is more and more difficult for citizens to understand what services are accessible with their library card. For many, the library is simply a place where physical books can be borrowed. The library website is the right place to show that the service portfolio is actually much broader. During the study it was observed that it is often not easy to find an overview of all the services offered by a library. Patrons need to find their own way to get a general overview of the full range of services that are often scattered across various websites, blogs and other social media. In order to provide citizens with an overall picture of their library's services, it is important to publish the local library's full service portfolio at least in one place on the library's website.

2. Library website guidelines

The design of a website offering online services is as important as the building of a physical library. The more information, digital collections and online services become available, the more important it is to present them in a structured way and to clearly indicate how to access them. Today, searching within collections is possible thanks to the Bibliotheekportalen project. Still, the services offered by public libraries go beyond just collections search. A library website must integrate and promote all of the library's services. In order to set up a professional library website, it is necessary to pay constant attention to:

- Development: what technology, standards, and systems are needed to provide online services with maximum reach, on a maximum of devices (including mobile devices)?

- Information architecture, usability and interaction design: how is the information organised, classified and presented in such a way that everyone can easily find their way? Can patrons use the services in an intuitive manner?

- Copywriting and online marketing: how are services presented in an attractive way? How are they promoted online?

- Online User Testing and Measuring: are interrogation and test methodologies in place in order to demonstrate that the online services perform adequately? How do we measure website usage?

The methods listed above are the same for all libraries. Therefore, it is recommended to draw the attention of libraries and municipalities to them for libraries websites guidelines that aim at building and maintaining professional, useful and contemporary library websites.

3. Locally reusable library website template prototype

Due to the increasing number of digital collections and online services, the library website will become more and more important in the future. The study enabled us to observe that online services are deployed at different speed across the sector. These differences in speed partly depend on the capabilities of the current web platforms used by the municipality or province. The ability to integrate the library's services within the library's website is crucial to the success of the digital library. For libraries that do not have the technical capabilities, a locally reusable website template can be developed. This reusable website must allow local "branding", customisation and content (local pages).

4. Pluggable services and common web tools

When new library services are developed (such as e-book lending), it is necessary to build them so that they are "pluggable" into the local, regional or sectoral websites. Library websites should be able to function as "service consumers" that consume external, municipal, provincial or social media services[5]. New forms of service can be supported by providing a web-app that can be promoted by all libraries through the local website (e.g. a pluggable e-reading app including public and personalised bookshelves, with lendable e-books and reading suggestions).

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[5] See final report: Online Patron Services – Optimisation, chapter 4.5.4

Work Area 4: Identity and Access Management (IAM)

Membership in a local library is a prerequisite to access digital collections. How do patrons obtain and use those access rights in a user-friendly way on the web? Good identity and access management solutions are crucial for the further development of the digital library. They are also the key to providing personalised services.

Initiatives
1. Development of a Federated Identity and Access Management System
2. Establishment of a Customer Relationship Management System

1. Federated Identity and Access Management System (IAM)

It is important that the sector continue the development of Open Bib ID as a Single Sign On (SSO) and Identity Access Management (IAM) system.

Like the other systems of the digital library, Open Bib ID must be an open system that can integrate with other IAM systems so that citizens can use their existing accounts to accessing various systems. In order to integrate with partner IAM systems, libraries need to participate to a Federated Identity & Access Management system (e.g. "Where Are You From" (WAYF)[6] in Denmark). Such a federated system must allow a Single Sign On (SSO) with external partners such as CultuurNet (UitID) and other e-Government systems[7]. The initiative of building a federated system cannot be undertaken by the library sector alone. Libraries can play their part by putting the construction of an identity federation on the agenda of the right governmental organisation. In the long run, this federation principle can allow

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[6] WAYF where are you from: recycling of login systems and personal data http://www.wayf.dk/en
[7] See final report: Patron Services – IAM – Innovation, chapter 4.6.4

the library sector to reduce costs (fewer security systems to integrate) and offer citizens a better online public service experience.

2. Customer Relationship Management System (CRM)

Registered patrons can be addressed in a more personalised way than today (e.g. by offering reading recommendations). If the patrons' profiles data is managed by a CRM system, it can be used for marketing purposes such as sending personalised newsletters. It is recommended to work on a shared CRM strategy within the library sector and/or with the municipality[8].

Work Area 5: Digital Collections

Due to the ever-growing proportion of purely digital content, libraries need to expand their current collections with new digital collections and services. More and more people expect to be able to digitally borrow something when they visit the library's website.

Initiatives
1. Development (or improvement) of a library e-book repository
2. Development of e-book circulation and access systems
3. Development of an integrated circulation management system for physical and digital collections

1. An e-book repository for libraries

VEP-R, the e-book repository of the Flemish e-book platform, is under development as a basic infrastructure to provide library members with temporary access to e-books. The e-book repository is built in an open and modular way, so that other library systems can make use of its services.

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[8] See final report: Marketing, communication and promotion, chapter 4.2

Other services that can rely on VEP-R services are, for instance, electronic rights management systems, online bookshelves, e-lending and circulation processes for e-books, e-publications archives...

2. E-book circulation and access[9]

Access to the library's e-books must be controlled using the patron's membership information. Therefore, the library's circulation and access systems need to be integrated with the digital library's "Single Sign On" (SSO).

In addition, publishers, libraries, library collaborators, administrators and the patrons themselves must be able to access personalised user interfaces or dashboards where they can consult the data that matters to them: lending history, lending statistics per e-book, per library, per collection, per user group...

The management and control of e-book lending transactions is crucial for the negotiation and the payment of e-book usage rights.

This is true for all forms of digital collections and related services. The e-books collections and services are only one of the first in a long list of digital services to come.

3. Integrated circulation management

For a uniform user experience and for the management of the digital library, a consolidated view of lending transactions for physical and digital collections is needed. The integration of the various circulation processes is important for both patrons and the library's management. KPIs must allow to follow the balance between physical and digital services in an integrated view. Indeed, for patrons, the availability of a specific title can be more relevant than the resource's specific medium (physical or digital). The content suppliers' business models can also differ from one supplier to the next. The availability of digital content at the library can than change over time.

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[9] See final report: Circulation – Innovation, chapter 4.8.3

Therefore, it is important that the library work with flexible systems that can deal with this continual change.

Work Area 6: Collection Management and cataloguing

The actual collection management processes for physical resources can still be optimised. At the same time, the collection management processes need to be extended to digital resources. The standardisation of and the best practices for (meta-)data, meta-content and digital objects depend on the evolution of international standards.

Initiatives
1. Integration and automation of collection management processes
2. Decisions about data publishing/linking using the semantic web
3. Adaptation of central cataloguing and data format to a "web of data"
4. Definition of a strategy for the management of special collections

1. Collection Management integration and automation

The study allowed to observe several parallel projects aimed at consolidating purchasing management, collection building and the related order management processes. These projects demonstrate the need for central data collection and for a Business Process Management (BPM) platform that will eventually provide a better understanding of which parts of the collections are used by which types of users. As cataloguing processes are not integrated with order management processes, the information needed for the circulation processes (labelling, metadata for the Internet...) arrives too late for some parts of the collections. A BPM platform must help access more systems and data, and help improve the efficiency of the library's business processes.

2. Publishing and linking using the semantic web

Since the early years of the web, there has been talk of the "semantic web", where information objects can automatically be linked together through data on the web. The objectives of semantic web data are, on the one hand, to describe and visualise all connections between people, subjects, objects, etc,, and, on the other hand, to make those descriptions as reusable as possible. Co-creation, data openness and the use of web-specific protocols and data formats play an important part in the semantic web. Because the Dutch-speaking community is relatively small, opportunities to link and reuse existing semantic web data sources for the benefit of the libraries are relatively limited. Apart from Wikipedia, there are few open data sources available in Dutch. The Flemish library sector could, however, play a part in the co-creation process and decide to publish open data. In the Netherlands, public libraries participate, through a Bibliotheek.nl project, in the co-creation of open data on Wikipedia. Boek.be is also active, with similar initiatives for information on authors.

3. Adaptation of central cataloguing and data format to a "web of data"

The current cataloguing systems, which make the use of Marc21 as their data format, need to be refactored in order to expose data elements to a wider network than just the public library network. The linking of data elements, for instance linking an author to a publication, is based on the availability of unique identifiers. An international unique number for an author allows to reference and consult the information about this author on the web. Through the years, the cataloguing process in the Vlacc central catalogue has paid a lot attention to the correct use of identifiers such as ISBN for books. The possibilities offered by the semantic web require that even more identifiers be managed. For instance, one can link a publication to its various translations. The Open Vlacc cataloguing system (based on Aleph) and the Marc21 data format aren't designed for the management of data element identifiers. Therefore, libraries will have to follow international trends

(e.g. BIBFRAME[10]) and adapt cataloguing systems and data formats. This is not only needed in order to link to and reuse data chunks, but also to align the physical and digital collection management processes. Cataloguing is required for the management of administrative processes and services as well as those related to public collections. It is important to provide maximum support to those processes and services, with a cataloguing system that allows to reuse meta-data (e.g. ISBN, titles, authors...) and meta-content (e.g. book reviews, author information...) in different contexts. Future Content Management Systems and cataloguing systems need additional semantic features that will allow to specify the context of a data element and how it can be linked with external content[11].

4. Definition of a strategy for the management of special collections

Special collections are publications or objects that are not part of the collections typically found in a public library (e.g. patrimonial collections, music partitions, toys...). Local cultural authorities often provide access to those special collections to library members. The study allowed to observe that the description of the special collections requires other data formats, collaborations, encoding conventions and graphical user interfaces than the ones used for standard library collections. Only a case by case analysis will allow to determine if the management of special collections can be done using the standard infrastructure of the public library or if it requires special software.

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[10] See final report: Cataloguing – Innovation, chapter 4.10.3
[11] See final report: Adaptive Content by Online patron services innovation, chapter 4.5.5 and Linked Data and Patron Services – Referencing and Information, chapter 4.7 and Collection Management, chapter 4.9

Work Area 7: Architecture consolidation (SOA)

The results of the work areas projects need to be integrated into a global system architecture. This requires working on the harmonisation and standardisation of the digital library's system architecture. Systems which currently support stable and non-differentiating library business processes need to be consolidated in order to reduce the architecture's complexity and optimise its cost.

Initiatives
1. Systems Integration governance and systems architecture consolidation
2. Setting up of a Library Hub (Return On Investment, decision and setup)

1. Systems Integration governance and systems architecture consolidation

The inventory of systems established during the study shows that a relatively high number of ICT systems are in use today[12]:

- An average of 9 local systems per library, plus an average of 4 municipality systems

- An average of 4 systems per province/region

- 16 systems provided by Bibnet (Flemish Government)

- 4 national and international systems

All those systems, even if they are not all connected to each other, form the digital library. The patron experience, even for standard library processes (e.g. circulation, renewal), is very often different depending on their library membership. As a consequence, the general digital library experience is complex for the patron, and also complex at the back-end when related systems need to be coupled in order to offer an integrated service. Given the evolution towards an increase of digital contents and a business-critical digital library, the expansion of library services may not lead to ad-hoc

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[12] See final report: AS-IS ICT applications used by the public library network, chapter 3.4.2

custom systems expansions and connections. Therefore, it is advised to consolidate and reduce the number of systems in use today, in order to reduce complexity and eventually reduce costs. The integration of library components (systems, modules, RFID, hardware...) needs to follow clear guidelines based on principles such as standardisation, efficiency and manageability.

2. Library hub

The systems architecture blueprint for the future of the digital library contains two important elements:

- Building a Service Oriented Architecture (SOA)
- Transitioning from "integrated" to "open and modular" IT systems so that the sector is able to choose different software/suppliers for each business process.

This open and modular approach shines when using a hub as middleware for the integration of the modules in the network: the library hub. This layer ensures that all systems are connected to the library network using agreed-upon formats and protocols. This approach will reduce the risks associated to the current situation where most systems are connected with custom and proprietary solutions. Eventually, the investment in the hub will reduce the overall complexity and increase cost efficiency.

Given the central role of such a library hub in the architecture, its introduction must follow several important steps: establishing the business case and the expected return on investment (ROI), a broad and strong collective decision, and a qualitative implementation.

4. Conclusion

The inventory of systems currently used by the Flemish public libraries shows that the system's architecture contains over 3,000 system instances of more than 75 types (Integrated Library Management Systems, office software, web applications...). Considering that the evolution towards a fully online library has only just started and that ICT has become mission-critical for the functioning of public libraries, it is urgent to work on a robust infrastructure for the digital library.

The need for a robust infrastructure requires investing in a service-oriented architecture with an extra middleware layer. Eventually, this architecture blueprint will result in reduced complexity and increased cost efficiency.

Towards an open and modular system architecture

Integrated Library Management Systems (ILS) that bundle together all possible features and library components without providing an easy access to them are difficult to combine with a modern system architecture. Currently, several functions and data are locked into the ILS and are inaccessible to external systems. In the future, software modules developed by software vendors for libraries will have to be usable independently from each other and loosely coupled using well-defined Application Programming Interfaces (APIs). It must then be possible to connect each module to the library hub using established and documented standards.

Very few libraries use their ILS as a comprehensive solution. Many additional services are provided by collaborative projects within the library sector (e.g. public display of collections via Bibliotheekportalen). Libraries and provinces currently still pay for features and functions of the ILS that they don't use. Given the feature-richness and the flexibility required for the digital library, continuing with integrated library systems, even updated ones, is not desirable. ILS suppliers have to repackage their products as series of modules that can be plugged as components within an open and modular system architecture. Obviously, suppliers may also offer additional

complementary modules as long as they can be easily integrated and are accessible by other systems and adaptable in a flexible way.
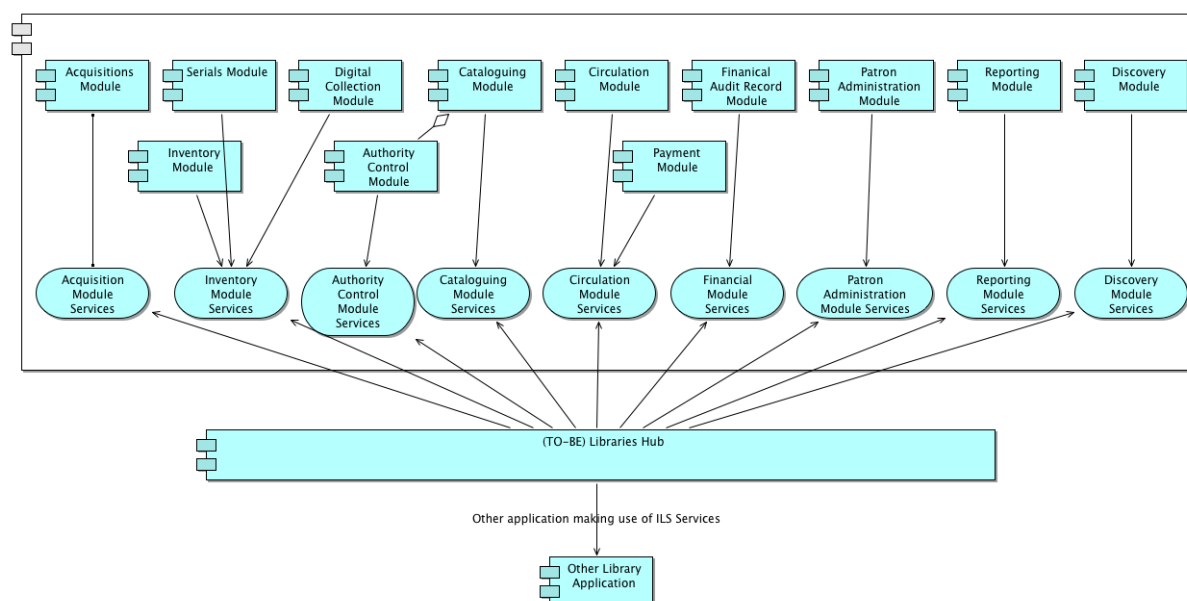

Figure – Overview of possible functional modules and services coupled to the library hub

The roadmap towards a full-service business-critical digital library - which is a part of the full library service portfolio offered by public libraries – requires the realisation of the 7 work areas that have been identified in the study. These steps will lay a flexible foundation that will allow for more flexibility in a constantly changing environment.

When looking at open and modular software for the proposed service-oriented system architecture, open-source solutions should also be considered. The inventory and evaluation of potential open source components is a natural and useful next step following this study.