

Implementing an opensource Higher Education and Research ERP at the scale of a country or State.

Case Study : The Malian Higher Education Information System

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1. ANYONE FANCY A COCKTAIL?

Cocktail is the name of a French opensource university ERP^[1]. It has been designed as a seamless resource management IMS/ERP for French universities and higher educational institutions. The project started in 1993 with the initiative of this article's author, Jean Marc Coris. At that time, he was CIO at the newly created La Rochelle University, SW France. Built incrementally upon a single data repository, it grew, over time, with the contributions of a community of developers, into a complete higher education -MIS/ERP, meeting the varying demands of French higher education institutions. As the authors and contributors were either civil servants or employees of public institutions it was a natural choice to license the product as Cecil Open-Source.

1.1. WHAT'S IN A NAME?

Why Cocktail ? The name of the initial data repository was G-RHum (Rum in French), the name "Cocktail" was born when the majority of French overseas universities (especially the French Antilles) adopted all, or part of the ERP as their SIS management system. They then added their local contributions or "flavors" ☺. The rest is history!

Today the ERP is used partially, or fully in over 80 higher public education establishments in France and the overseas territories (Universities, Engineering schools, Veterinary schools, ...) as far away as Tahiti and New Caledonia.

2. THE FINANCIAL CONTEXT

The project was made possible thanks to funding from the Government of the Netherlands as part of the tender NICHE/MLI/215^[2]. This project, amounting to 3M€ of funding was implemented in synergy with the PADES^[3] project funded by the World Bank through the Dutch consortium provider CINOP Global^[4].

^[1] <https://www.asso-cocktail.fr/>

^[2] https://www.cinopglobal.com/79_1498_A_thrilling_challenge__NICHE_MLI_215.aspx

^[3] <http://documents.worldbank.org/curated/en/143421533138728365/RAPPORT-DAUDIT-PADES-MALI-207>

^[4] <https://www.cinopglobal.com/home.aspx>

A budget of 450k€ was allocated to the Student Information System ERP project over a four-year period from 31/08/2014 to 31/08/2018.

There was also additional funding from:

- the French embassy (# 30k€).
- the World Bank for additional developments. (# 150k€).
- and a one-year extension of the initial project by the Netherlands government: 150k€.

The total funding of the project amounted to 780k€.

3. PROJECT SUMMARY

The Malian Higher Education and Research sector faced many challenges affecting both its internal and external efficiency and effectiveness. These included poor governance, limited quality and relevancy, gender inequalities and inequities, mismatch between offerings and labour market needs, etc.

Related to the foregoing, Mali launched an in-depth reform process of the sector since 2011. This complete overhaul of the system aimed to change drastically the system to enable it sustainably play its role efficiently and effectively towards national development.

In this context, the Republic of Mali had the ambition to facilitate the implementation of the Bachelor, Master and Doctorate (BMD) curriculum throughout the country's higher educational institutions. To do this a student management information solution to improve governance and efficiency, both at Ministerial level and at local, institutional levels was prescribed.

The choice, and the challenge, was to implement a unique fully integrated student management information system in all the higher-education institutions throughout the country.

Following the public tender for procurement by the Malian Ministry of Innovation and Scientific Research (MESRS) the ERP Cocktail+ was retained. The integration of the solution was entrusted to the open source services company *Cocktail Office*. Cocktail+ is the updated, multi-establishment version of the ERP Cocktail.

It is important to mention that the SIS software block *Cocktail-ScolariX* had been designed specifically for the implementation of the French reform of the BMD (Bachelor, Master, Doctorate, LMD in French) curriculum in 2002 in conformity with the Bologna process^[5]. The Malian higher education system is also based upon the BMD framework.

The perquisites were prioritized as follows :

- The system had to be scalable to cope with large numbers of simultaneous enrolments on a national scale.
- 100% digital and dematerialized enrolment and admission workflows.
- Global web access to university programs and curriculums.
- An online enrolment for selective or non-selective curriculums.
- Automated bulk or individual admissions and course orientation.
- Automated bulk pre-enrolment.
- Bulk or individual student diary management for admissions appointments.
- Mobile web phone payment integrated into the ERP.
- A "Fast track" registration mode (Enrolment validation with printed reports thus reducing the workload of institutional staff);
 - Bulk or individual printing of pdf format student cards,
 - Direct pdf printouts of receipts and paid invoices,
 - Direct pdf printing of attendance certificates per unit or batch.
- A secure low-cost plastic credit card format student ID card (no unnecessary onboard technology).
- Offer new and economical digital services for the students, accessible throughout the country.
- A collaborative digital work space and virtual learning environment for students and staff alike.

^[5] https://en.wikipedia.org/wiki/Bologna_Process

These prerequisites were mandatory for all public higher education students and were necessary to enable the resource management of the student lifecycle with the SIS using web service-based technologies.

The initial objectives were not solely limited to enrolments and admissions, but also to curriculum management, human resources (staff) management, asset management, financial management and research management.

4. THE CONTEXT

Implementing a centralized SIS ERP on a nationwide scale in one of the poorest countries in the world was not without challenges.

First and foremost, different factors had to be taken into consideration:

- The Republic of Mali is one of the poorest countries in the world. The United Nations Human Development 2018 updated Index ranked the Republic of Mali 182nd out of 188 countries, (Norway being 1st, France 24nd) [6].
- The surface of Mali is 3 Mali (1,240,192 km²) is 3.8 times as big as Norway (323,802 km²) [7].
- Before the country's independence in 1960 the Republic of Mali was under French colonial rule (French Sudan). This greatly influenced the country's administrative organization, rules, regulations and education system.
- The existence of a powerful student union (AEM) whose point of view had to be considered.
- A very "paper based" culture in the different ministries and administrations.
- An unfounded, "irrational" resistance to online payments.
- Low internet connectivity (in 2014) with only 19% of the population have access to 3G+ [8].

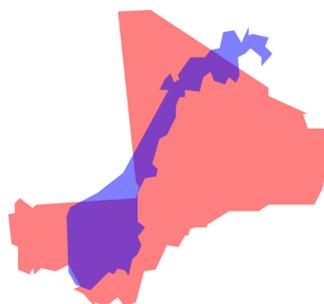


Fig 1. Comparison of the surface of Mali with Norway
Source : <https://mapfight.appspot.com/>

4.1. HIGHER EDUCATION IN THE REPUBLIC OF MALI - KEY FIGURES:

- 100 000 students (approx.).
- 3 500 staff (over 3000 with civil servant status).
- 12 public higher education institutions: 5 universities and 7 engineering schools.
- Between 25 000 and 30 000 new graduate bachelors per year.
- Annual fees per student:
 - Annual tuition fees: 5000 XOF
 - Cost of student ID Card: 1000 XOF
 - 6 000 XOF = 87,88 NOK = 9.15€ (XOF = West African CFA Franc)

[6] <http://hdr.undp.org/en/2018-update>

[7] <https://mapfight.appspot.com/ml-vs-no/mali-norway-size-comparison>

[8] <https://www.orange.com/fr/Groupe/Orange-dans-le-monde/Pays/Bienvenue-chez-Orange-Mali/Mali/Les-reseaux-d-Orange-Mali>



Fig. 2 : Evolution of the student population in Africa,
Source Ministry of Higher Education and Scientific Research, Mali

5. THE TECHNICAL CONTEXT

The initial situation (2014-2015) in the Malian Higher Education institutions was very disparate from one institution to another in terms of admission and enrolment workflows, technical infrastructures and HR staff skills.

At this time private network infrastructures (campus and intra-establishment) were insufficient and there was a limited national infrastructure for the interconnection of higher education institutions. Two telecommunication operators share the Malian telephone market: Malitel (a Moroccan operator) and Orange Mali (French operator) with, in 2015, a limited 3G coverage and a limited "box" offer. In the public sector computer skills existed but were spread over the territory and were rare because of the strong attraction to the private sector.

6. PROJECT PROGRESSION

From the start certain difficulties were encountered:

- The ambition and goals of the Malian Ministry of Higher Education and Scientific Research were not fully understood or shared by all the institutions and users.
- The project had to involve simultaneously ALL of the higher education institutions. This greatly increased the overall complexity and management of the project.
- Establishments had difficulty comprehending the motivation and the end benefits of deploying a centralized admissions software system.
- A proposal to create a POC with 2 voluntary pilot institutions was unfortunately not retained.
- Limited internet access to the population complicated access to webservices.
- The absence of an administrative Intranet information portal
- By default, a resistance to change, without considering what the changes were.
- The military and political situation in Mali limiting travel outside Bamako.

6.1. THE FIRST PHASE: YEAR 1

The kickoff meeting and project launch was held on the 2nd of November 2014. Following the meeting a project management mini-website was created and the community of users and actors were divided into thematic groups, mailing lists, document and diary sharing facilities were implemented.

To understand the system requirements a survey was launched. The results enabled the definition of the system requirements and allowed the database design and the first simulations of the ERP. Technical experts from France dispensed onsite training for the project managers, the developers and key stakeholders.

A key element was the construction of the national information system reference system, an essential element for the implementation of the different software bricks and their integrated management tools.

In August 2015, after 10 months of intense preparation and software development, the system went online as planned, enabling for the first-time student enrolments at a National scale for the new academic year. The Campus Mali[] portal was on-line!



20,000 future graduates pre-enrolled online to their universities using their smartphone, or from cybercafés or via stands from Orange Money, the online payment partner. The calendar was respected. This was also achieved by taking the option to host the information system and its software environment with OVH (in Europe), freeing us from any material, technical, logistical and technical constraints. This was not only a technical challenge, but also a very political one!

However, at this successful point of the project, paradoxically a certain “wait-and-see” attitude was experienced. Had things gone too fast? Maybe some actors felt “jostled”. Some institutions continued their final steps of the admission process the “old-fashioned” paper-based way. The technical feasibility had been proven thanks to the national 3G network coverage available for the students, but ironically it was found to be insufficient within the establishments. This situation encouraged the admission services to continue to enroll the students as before, using the paper-based system, paying the tuition fees in cash and even filling in forms with information that was already present in the database.

6.2.SECOND PHASE : THE FOLLOWING 3 YEARS

After the initial launch and enrolments, the project continued to evolve. There were several aspects contributing and impacting this second phase :

The technical aspect: This included further software developments, functional adaptations and extensions as well as consolidating the ERP. Batch retroactive enrolment was performed for all the students that had been enrolled outside ERP the 1st year.

The administrative aspect: The rule imposed by the Ministry and the CENOU (National student service agency) was that scholarships would only be paid to students who enrolled through the ERP. This strongly contributed to incite institutions to use the centralized admissions system, but it was not without some difficulties and resistance!

The Human Resources aspect: Even though it was a particularly time-consuming task, the support, assistance and skills transfer to local administrative and technical staff enabled them to become completely independent by the 31st of August 2018, thus being able to maintain and operate the ERP. "Campus Mali", a national support center was created to accompany the users of the ERP. Skilled support personnel was trained to deal with requests and support.

It was interesting to note that the Ministry requested to have its own Datacenter to ensure data storage on the Malian territory. This was however contrary to our security recommendations.

The positive results of the first enrollment session, encouraged the World Bank and the French Embassy to allocate additional funding. This funding was used for :

- The development of a responsive design public institutional portal www.campusmali.ml.
- The integration of G-Suite (Google Apps) with the ERP, offering all students and staff a free collaborative digital environment.
- The creation of a student mail address @campusmali.ml and a staff mail @mesrs.ml.
- The dematerialization of administrative workflows.
- The full integration of online payment with the ERP (Webservices) using an electronic wallet or "mobile money" integrated into cell phones (Orange Money and Mobi Cash).
 - This is a method of payment widely used in Africa that does not require the person to possess a bank account.
 - The purchase of credits is made directly via the telephone operators.
- A global SSO/CAS/LDAP for all the Malian students and staff ;
 - A unique identifier for students and staff within the ERP for the duration of the lifecycle.
 - Setting up an SSO, based on a centralized CAS server and an LDAP directory, including automatic synchronization between the LDAP and the ERP.
- The integration of the private Higher Education Institutions into the Ministry's public SIS cloud ; The ERP was adapted to discriminate between public and private higher education institutions.
 - 13 pilot private institutions were able to use the ERP for the 2016-2017 enrolments.
- Possibility to anticipate high school leavers: The ERP was adapted to allow the implementation of a pre-enrollment process.
- Sending individualized SMS messages via the OVH platform.
 - These messages were implemented to validate the creation of user accounts and send logins and secure passwords. This proved to be the safest and most efficient method to contact the students.
 - Google-Calendar's free SMS message alert system was used for individual notifications. It was then replaced by Google's notification system when Google abandoned their SMS alert system.
- The dynamic management of student diaries to fix appointments at the institution's admissions desk.
 - This added feature encouraged institutions to structure their admissions desk, sending invitations and planning appointments with the students.
- Simplified access to digital resources
 - The SSO global connection allows easy access to online resources such as the online Human sciences repository [CAIRN.info](https://www.cairn.info/)^[9] .
- A basic InfoCentre offering a wide range of analytic applications, dashboards, and descriptive reports along with support for ad hoc analysis for KPI's

[9] <https://www.cairn.info/>



Fig.3 Campus Mali Backoffice and InfoCentre portal

The implementation of the ERP imposes the institution to organize and define its administrative processes. This is one of the main advantages, but it is also perceived by some, as a constraint, and that was a disadvantage!

7. ARCHITECTURE

The ERP architecture was hosted by OVH. The basic infrastructure was three physical servers running ProxMox and 14 virtual servers. (for an annual cost approx. 3 000€). This architecture ensured high-availability 24/7/365 for the system. A virtual instance of the ERP was allocated to each establishment, thus guaranteeing data isolation and system performance separation between institutions. Each institution has its own impervious student information system (SIS). The impermeability of the data and the processes between establishments is thus secured. It is however available for the Ministry and top-level administration.

The cloud architecture has had the positive effect of encouraging and accelerating the finalization of IP network infrastructures, at both inter-establishment level, and within the institutions themselves.

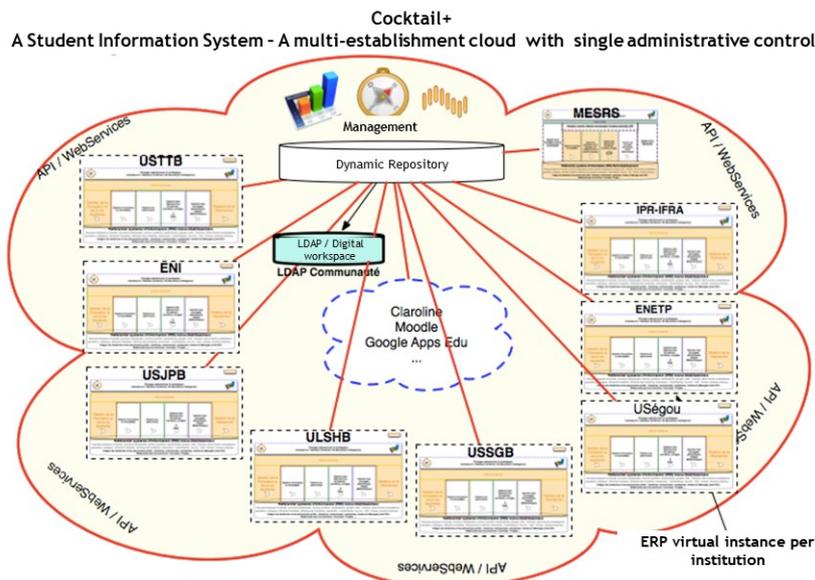


Fig. 4 Logical schema of the SIS ERP Cocktail+.

8. RESULTS

Suddenly real-time student data monitoring became a reality for the Malian Ministry of Higher Education and Scientific Research. Student data analytics, trending, decision making and performance monitoring, either at a national level, at an institutional level, or by “virtual groups” of institutions became possible, based for the first time upon reliable data.

The multi-establishment ERP allows the self-management for each of the autonomous institutions of the MESRS. Sharing public data from the central repository is possible. Data from institutions may also be shared

A highly anticipated feature for the Ministry was the ability to produce in real time a national student directory. The delay with the “traditional” system was on average 18 months.

Finally, ALL staff and over 80 000 students have a unified access to a collaborative digital workspace whose functional wealth puts Mali, for the services offered to its users, at the top of CAMES Council (African and Malagasy Council of Higher Education)^[10] countries and probably Africa.

9. DIFFERENTIAL BETWEEN PROJECT GOALS AND DELIVERABLES

At the date of 31/08/2018 the entire allocated funding has been consumed.

The envisaged objectives in terms of functional cover of the ERP was however not attained.

Technical and software priority was given to training management, data repositories, active human resource management, financial asset management and interoperability in terms of integrated management and governance.

More onsite missions were necessary than initially planned. This consumed a larger part of the budget than initially calculated but have proved to be indispensable to complete transfer skills to the stakeholders.

As a consequence, the following features were not adapted or were not developed:

- Financial accounting, with the exception of student admission revenues.
- HR careers and vacation management : Regulatory adaptations would have been too costly to implement.
- Research management: This sector was not a priority for the Ministry

10. PROJECT EXTENSION

An additional funding of 150k€ was allocated to enable an extension of the project for one additional year ending 31/08/2019.

The aim was to finalize the information system in terms of student and staff data and ensure independence for the local staff to operate and administer the technical infrastructures.

This is achieved by numerous onsite long duration training sessions, technical support and skills transfer.

11. FURTHER DEVELOPMENTS AFTER 31/08/2019 .

- A maintenance and support contract with the MESRS has been signed to take effect from the first of September 2019.
- Further developments to fully incorporate the private higher education institutions in Mali.
- Obtain additional funding from the World Bank to extend the ERP to the secondary education system incorporating approximately 1 100 public and private grant financed high schools.

^[10] <http://www.lecames.org/index.php/>

11.1. EXPORTING THE ERP

Because of the design and architecture, exporting the ERP to other countries is feasible with minimal investment. This is especially true when the education system is based on the DML cursus.

This is already the case in Senegal, the Ivory Coast and Tunisia where the ERP is being tested with several pilot institutions. The investment is limited to support services and training (minimal or no new developments are necessary).

The Ministry of Education of Chad has expressed interest in a bilingual French-Arabic version.

To adapt the ERP to other countries, investments will be necessary for:

- the adaptations and customization
- the initial configuration of the ERP
- the preparation, configuration and initializing of the data repositories.
- training and support services

The Nigerian Federal Ministry of Education has also shown interest in the project. However, one must consider the cost of adapting the ERP to the Anglo-Saxon education system, and developing an English version for the limited number of further education establishments that are present in the country.

Our market research and in-depth knowledge of French-speaking Africa shows that the current version of the ERP may be deployed with little investment. The ERP is conforming with the DML education system framework. Adaptations for special reports, specific dashboards and the adjustments of certain administrative workflows and procedures would be needed.

The ERP has been developed and adapted to the characteristics and specificities of the Malian Higher Education system. These specificities are shared with the other members of the CAMES. It is thus with little investment (financial and human) that the case of the Republic of Malian Higher Education System could be reproduced in other member States.

12. CONCLUSIONS

The project was initiated by Ministry of Higher Education and Scientific Research. The different actors participated in the project from the start. They have benefited from training, skills transfer and technical support to enable them in the long term to be independent and autonomous.

The system offers an “e-governance” framework for the Ministry making it easier to monitor, track and evaluate the different institutions. The centralized data enables BI predictive analysis and forecasting of trends of the country’s institutions.

The different actors have realized the important benefits of the system; new digital online services available for the students, (for example a student can now obtain his student ID Card with a “one click” validation), the economies of scale for the global budget, the fluidification of admissions and enrolment processes. It was also seen to be a significant element in reducing fraud, particularly for the management of scholarship attributions in a country where 90% of the population are awarded scholarships.

The implementation of an ERP in an organization imposes a framework and obliges to clearly define the rules and processes. This may not have been the case before, when the practices were more empirical. This new organization was perceived by certain institutions and their staff as an increased workload, slowing down the different procedures. The fact that certain activities and procedures within the ERP were now traceable was not always understood, or welcomed by everyone.

This is the fourth academic year that the SIS “Campus Mali” is used for student admissions with over than 80 000 students enrolled we can say that the point of no return seems to have been reached. The need to justify the new centralized system is no longer an issue.

However, at the end of the 4 years, it became clear that the beneficiary was unable to be totally independent, with the choice to run the ERP the technical infrastructures that were hosted on a local data, center replacing the initial choice of OVH hosting.

Unable to take the risk of a loss of the investments and a return to the “old ways”, the project consortium CINOP Global, with the agreement of the Government of the Netherlands, decided to fund an additional envelope of 150k€ for an additional year.

This Higher Education ERP, deployed on a national scale, that includes such a high degree of data integration, could be considered as unique.

13. AUTHORS' BIOGRAPHIES



For over 25 years Jean-Marc Coris has been the CIO in different French universities ; La Rochelle (SW France), Marne la Vallée, Paris 5 Descartes, Provence (Marseille) and then as digital transformation leader at the University of Aix-Marseille.

It was in 1993 when the University of La Rochelle was created that he created what was to become the Opensource community driven Higher Education ERP “Cocktail. Cocktail is now present in more than 80 French Higher Education establishments. The original Cocktail consortium became the Association Cocktail in 2010. In 2013 he left the association to become the CEO of the Open source services company “Cocktail-Office”. He has worked closely with the Ministries of Higher Education in several North African countries, working with Algeria, Tunisia, The Republic of Mali and the Ivory Coast.



Stuart McLellan arrived in France from Scotland in 1984. After working in the private sector in various IT services companies (where he met the 1st author and contributed to Cocktail), he integrated La Rochelle University, as a network and systems engineer. After specializing in HPC infrastructures he joined the prestigious Ecole Normale Supérieure de Cachan in 2007 as head of Network, IT infrastructures, HPC and ISSM. He was appointed CIO in 2011. In 2015 he became the CIO of the French national Natural History Museum in Paris. These institutions use the MIS/ERP Cocktail. In January 2018 he joined the French NREN RENATER where he is now the regional REN activity Manager.