NOVA IMS Information Management School

MGI

Mestrado em Gestão de Informação
Master Program in Information Management

Software architecture based on XML messages in a project for secondary loan trading

Internship report

Slawomir Piotr Majewski

Internship report presented as partial requirement for obtaining the Master's degree in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

SOFTWARE ARCHITECTURE BASED ON XML MESSAGES IN A PROJECT FOR SECONDARY LOAN TRADING

by

Slawomir Piotr Majewski

Internship report presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Business Intelligence and Knowledge Management

Advisor: Vítor Duarte dos Santos

Co Advisor*:* Joaquim Botelho

ACKNOWLEDGEMENTS

Finishing this report I could not pass the opportunity to say thank you to all the people that have been by my side in BNP Paribas, working together with me to accomplish this project, but also those that have supported me while writing this report.

Above all I would like to thank Professor Vítor Santos who has guided me through the whole process of writing this report and who upon one failed attempt to write on another subject pointed me in the right direction and suggested writing a report detailing my professional work. It has been so much easier going through the whole process with his invaluable guidance and advice.

Secondly I would like to thank my colleagues in BNP Paribas with the special gratitude for Joaquim Botelho, my colleague when the project started and currently my team leader. It has always been, and continues to be a pleasure to work by your side, I would like to express my appreciation and recognition for the help and assistance offered when the project was on-going and now for taking the role of my co-advisor and helping me to write this report.

Last but not the least, I would like to thank Miguel Lúcio, Ida Vetelainen and Joanna Kuczamer for their continuous encouragement and support that guided me until the report was terminated. Your help was priceless and has made it much easier for me to finish this work knowing you were by my side, always believing in me and making sure I don´t lose track of the final objective of finishing this report. Thanks You!

ABSTRACT

In many business cases having a single application serving multiple technical and functional purposes is not a viable solution, especially in financial or banking environment which requirements are especially demanding considering the simple fact that there is money involved. Design of the appropriate software architecture and the following maintenance of the quality of data is possible thanks to the utilization of XML messages that permit establishing a connection between various applications. The flexibility of such solution allows the information to flow through designed architecture and be integrated according to the rules specified.

This report details a project realized in a multinational investment bank in the business line of secondary trading for syndicated loans. The structure developed on the technical level was not tailor-made for the software utilized across three different locations and required adjustments and further developments in order to achieve properly functioning infrastructure. This work describes the phases of the project, its challenges and finally an overview of solutions developed, but beforehand provides the reader with a background information on the business the project is realized for as well as the software involved in the infrastructure designed.

KEYWORDS

Software architecture, XML messages, Secondary loan trading

INDEX

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

CDO	Collateralized Debt Obligations
CLO	Collateralized Loan Obligations
ID	Identifier
LMA	Loan Market Association
LSTA	Loan Syndication and Trading Association
XML	Extensible Markup Language

1. INTRODUCTION

Before the project was executed, the loan trading activity for BNP Paribas was booked in Paris and the main reason for this transition to occur was the regulations of the French law. The French Banking monopoly prevented BNP Paribas Paris to transfer loans by novation or offering participations on loans directly to the accounts that belong to non-banks such as funds, CLOs and alike. The way to work around this law was for BNPP Paris to effectively sell loans to non-banks, it would need to sell them first to BNP Paribas Netherlands which then would face the end-investors. Both trades would occur on the same date, however BNPP Netherlands would not be able to handle loans participations or sub-participations. Since the trading desk was approached by many potential participations buyers and not being able to offer such settlement method, the Secondary Loan Trading (SLT) project was born as a way of overcoming constraints and limitations of French regulations. The project entailed moving the trading activity from Paris to London. The project also aimed at improvement of the system for booking the activity by design of a dedicated infrastructure. The project itself involves BNP Paribas Corporate Institutional Banking (BNPP CIB) – which maintained the trading activity but transferred it from Paris to London books – and BNP Paribas Securities Services (BNPP SS) – which offers loan administration and back office services. The technical infrastructure involves 3 main applications: MOON and Nevada (BNPP CIB) and Scout (BNPP SS) that are connected allowing the information to flow with changes being input in any of the systems; and reports designed to allow reconciliation between various systems but as well these generated for accounting purposes.

1.1. INTRODUCTION TO SYNDICATED LOANS

Traditionally the ways for companies and corporations to raise funds for their investments have been limited to more conventional solutions like single bank loans and issuance of equity. Nowadays the innovative changes in the financial market over the last decades allow companies to use more complex and sophisticated ways to finance their investments. Syndication loans have become a major global financial instrument that not only permits the borrower to gather vast amounts of funds – what would rarely happen in a single lending – but also mitigates the risk for the lending organizations which share the exposure to the possibility of borrower´s going default and not being able to pay back the loan. In a syndicated loan, the company or corporation in the need of the financing would search for a bank who would assist them in the issuance of their debt. The leading bank – usually a large investment bank - would take on the role of the arranger and find other banks that would be willing to participate in the syndication. The exposure to risk of this syndicate of banks would be reduced due to the involvement of multiple parties. The arranger in most cases puts up a proportionally bigger part of the investment and takes on the role of the loan agent as well as the underwriter of the loan. As an underwriter the bank will work closely with the entity issuing the debt and being in charge of the administration of the issuance, including the distribution of the securities from the issuer to the market where the investors would be able to buy it at the determined offering price. As the loan agent, the arranger will be responsible for all the administrative tasks on behalf of the issuer. These tasks would include in particular three main roles: calculation agent, paying agent and registrar. The calculation agent calculates the share of interest and principal (repayments and prepayments of parts or totality of the loan back to the lenders) paid to each and single investor with

ownership of a position in the loan. The paying agent is responsible for instruction of all payments made to each participant in the loan as well as keeping records of their payment details. And finally the registrar would be in charge of book keeping in terms of all the position changes that could occur during the lifecycle of a loan since the initially sold participations – bought on primary market, meaning directly from the underwriter who would distribute them on behalf of the issuer of the loan – will change their owners with trades taking place on secondary market. The issuer can be the unique borrower in the loan but in many cases there will be various borrowers present in the issuance of the debt, in most cases organizations legally bound to the issuer like its subsidiaries or strategical, investment partners. All the parties involved in issuance of the debt would sign together the main document that specifies and defines all obligations and responsibilities of each party as well as determines the events and amendments that will occur during the lifetime of the loan. This document, called credit agreement will be therefore signed by the issuer, all participating borrowers, arranger and other banks in the syndicate created for the purpose of gathering the necessary funds and other possible entities like guarantors, loan agent – if different than the arranger, trustee – which is the control entity hired by the issuer to protect the interests of the investors. To encourage the investors, the loan might be set up with collateral of the issuer and borrowers that would provide additional assurance to the potential investors. Premises, properties, goods and products can be offered as collateral and they will be used to satisfy the rights of the investors in case of the loan defaulting and the issuer and borrowers not being able to pay back the debt they issued. It is within issuer´s control to divide and structure the debt in a way most suitable for them. The loan could be divided into various tranches with different levels of risk, which is to say with different levels of profit, what would allow the investors to accommodate their investment needs appropriately. The issuer has also the opportunity to divide each tranche into different drawings, each financing a different project or simply, each allocated to a different borrower that has signed the credit agreement. A structure of the syndicated loan could be presented graphically as below.

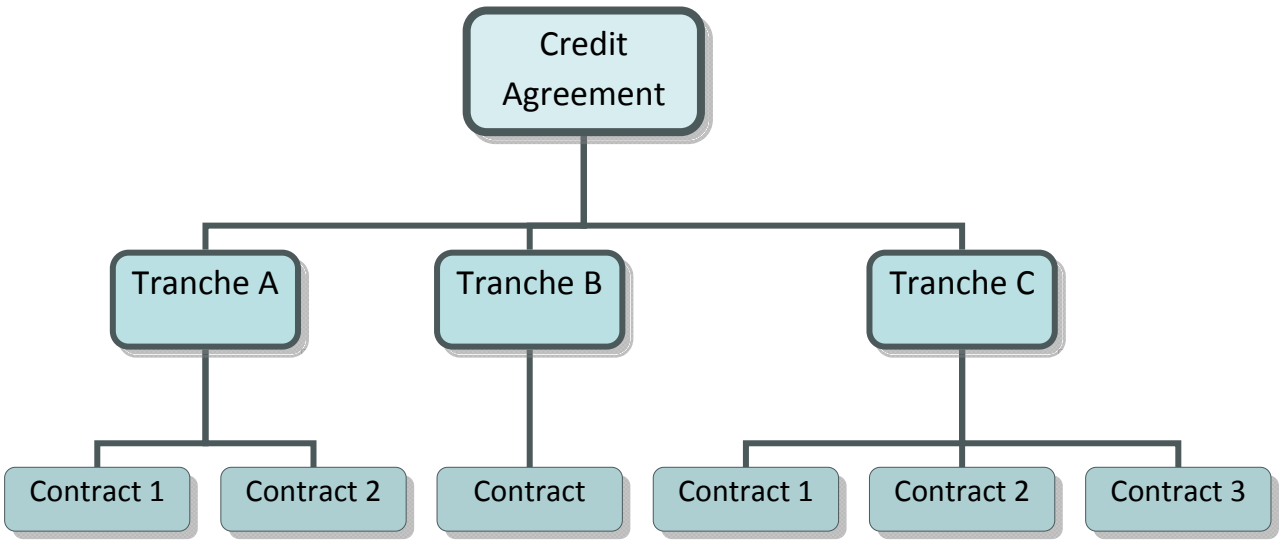


Figure 1.1 – Structure of a syndicated loan

Credit agreement would define the structure of the debt issued including its division into tranches. Upon signing the credit agreement the deal will be made effective and the funds will be drawn from the syndicate to the accounts of the issuer held with the loan agent or arranger. On the primary market the arranger will then sell the participations to the investors – investment and commercial banks or institutional investors such as pension or hedge funds or CDOs and CLOs. The investors create portfolios of assets and invest in many different syndicated loans by buying the participations on the primary market from the arrangers or on the secondary market from the other investors holding positions. This way the risk exposure is spread out across many different loans and even if some of them go default the blow taken by the lending organization is cushioned by the profit obtained from the other loans. The international secondary loans market has grown exponentially during last two decades and was worth almost 3.5 trillion dollars in 2007, in new loans issued what represented one-third of all the funds that were raised worldwide.

1.2. LIFECYCLE OF A SYNDICATED LOAN AND ITS CORPORATE EVENTS

The life of the syndicated loan will be dictated by various corporate events, and the loan agent will communicate them as well as any decision or amendment to the investment to the investors participating in the loan. The initial drawdowns will be allocated into contracts that as per credit agreement will accrue the interest with a rate that is periodically fixed. Considering this we could identify two main types of loans – fixed rate loans accruing with a fixed rate usually constructed by a certain established in credit agreement spread plus a base rate and floating rate loans that accrue interest with a rate that includes spread but is also base rate linked to a currency index that changes at each periodical prolongation called rollover. Throughout the life of a syndicated loan each drawing in the loan will undergo periodical rollovers with the most common ones being monthly and quarterly contracts. The traches of the loan will also be gradually repaid back to the investors in mandatory repayments that would follow the pre-established in credit agreement schedule called amortization schedule or in voluntary prepayments of larger amounts of the debt that would take place in case of the issuer having excess cash available. Across the life cycle of the syndicated loan the debt can be reorganized and restructured what would translate into splits and combines of various tranches and drawings. In some cases, if the credit agreement allows it, the initially issued loan could be at request of the issuer and the borrowers increased, however since it would require additional funds from the existing lenders it would call for their consent and involve payment of compensation fees. If everything goes according to the plan, at one point the investors are paid back their funds and the loan terminates. This could happen either at defined in credit agreement maturity date or at any point before.

Corporate Events will take place throughout the whole life of the loan starting with its effective date up to its maturity. The investors will be informed by the loan agent of each event in a notification sent to them in a form of an e-mail or fax.

1. Drawdowns, occur when the borrower draws the funds from the investors and are executed through the loan agent. In case of a term loan totality of the funds is drawn initially on effective date of the facility. If the credit agreement permits the issuer to increase the loan size and the lenders consent to it, there might be additional drawdowns taking place.

2. Rate-fixing and rollover. Initial drawdowns will accrue interest for an established period of time – usually one or three months, but in fact for practically and period of time up to one year. At the end of each contract, the investors will be paid the interest and the drawings will be prolonged for another period of time and the rate will be fixed for that period. The payments of the interest will be made by the loan agent who will also be the one responsible for notifying the investors about the rate fixing for the next period as well as the calculations of the interest amount each of them is due.

3. Principal repayments occur when the borrower repays part of the investment back to the lenders. Usually the payment date of these is predefined in the amortization schedule included in the credit agreement and in most of the cases it coincides with the maturity date of the contract. The payment is executed through the agent.

4. Voluntary prepayments, occur out of the amortization schedule when the borrower has excess cash and pays part or totality of the investment back to the lenders. The payment is done through the loan agent and in case of a partial prepayment can be accepted or rejected by the lenders resulting in different than proportional pro-rata payment.

5. Margin change, can occur as per the credit agreement and the spread used for construction of the rate will change. Since this amendment affects the investment of the lenders usually it will involve the payment of an amendment fee that will be paid by the borrower to the existing lenders through the loan agent.

6. Splits will take place when the borrower will need further re-organization of the loan. Any drawing can be split in one or more drawings that could roll for different periods as well as at different rates. Any funds allocated to the drawings affected will be allocated as per the established ratio.

7. Combines will occur when the borrower will decide to merge one or more drawings together as a part of debt re-organization. The funds allocated in the drawings affected will be combined together.

8. Restructures will occur if the issuer and borrowers will need to re-arrange the whole investment at general level or amend certain qualities of the loan that are – as per the credit agreement – not amendable unless the whole loan structure suffers alteration. For example

borrower merges three tranches with their respective drawings into one new tranche to alter the spread that was initially established. In case of restructures, the credit agreement envisions the payment of the amendment fee paid by the borrower to the existing lenders.

9. Fee payments are paid to the existing lenders when specific events takes place and are used as compensation to the lenders for the alterations done by the borrower to their investment.

10. PIK (Payment in Kind) increase, will be present in some of the loans and the interest that would normally be paid at maturity date of the contract, will be capitalized to increase lender´s participation and the base for the accrual. PIK will be present in more risky, unsecured loans as a mean of encouraging the lenders that would be compensated this way for taking the risk of investing in them.

1.3. INTRODUCTION TO TRADING

As mentioned before, trading can occur at two different markets: primary and secondary. Primary trading is when the investors buys the participation in a loan directly from the underwriter, which would normally take on the role of the loan agent. These type of trade will occur normally at the beginning of the life of a loan, when it is originally effective and issued to the market. There will be primary trades also when the tranches restructure and are re-introduced to the market as new repriced securities. The more common of the two, secondary trading, will occur with more frequency and can take place throughout all the life cycle of a syndicated loan. Secondary market trades will involve always at least three parties: the seller which is the current lender of record owning participation in the loan; buyer willing to purchase said participation and the loan agent that would accept the trade and control that everything is done according to the pre-established in credit agreement rules. The loan agent as a party participating in the trade will be responsible for updating their records by moving the ownership from one lender to another, what would also include an update to records kept in terms of notices sending and payment details. The loan agent will normally receive the transfer fee for performing these updates that would be equally split between the buyer and the seller. There exist two major institutions providing regulations and recommendations for trading on both primary and secondary market which are:

- The Loan Market Association referred to as LMA is an institution working together with lenders, borrowers, regulator and other parties to improve the liquidity, increase transparency and establish good practices for both primary and secondary loan markets in the EMEA region. Founded in 1996, LMA has been growing steadily and can ride itself in over 630 organizations as its members, spread among more than 60 different nationalities including some of the major market players.
- The Loan Syndication and Trading Association is a principal advocate for the American market for loan syndication since 1995. As the European counterpart LSTA works

with all loan market participants promoting their cooperation and inspiring the confidence of the investors.

Always when trading is concerned, there will be three dates present in every sale or purchase.

1. On trade date, the terms, amount and the price are initially agreed between the buyer and the seller. Some of the conditions that are initially agreed can change later on, for instance in situations when the loan restructures or simply when the traded amount has to be reviewed due to a repayment that the loan had in the meantime.

2. The expected settlement date is also agreed on the trade date, usually following the recommendations of the market associations for syndicated loan trading, being T+7 for the LSTA and T+10 for the LMA. The expected settlement date in most of the cases does not match the actual settlement date and serves mostly as a date on which the trade fees are going to start their accrual.

3. On actual settlement date, the trade settles which means simultaneous occurrence of the three events that are: the security is delivered from seller to buyer, the buyer pays the seller the agreed amount and finally the loan agent updates their records to accommodate this trade. Any delay between actual settlement and expected settlement date will result in accrual of fees that are discounted from or added to the final price paid to the seller, which also includes transfer fee. Before the settlement date the seller will need to provide the buyer with the current information on the loan traded, in terms of its tranches, drawings, their periods and rates. It is essential for the seller to communicate to the buyer all the events that occurred in the loan from the trade date when the terms were agreed, since any fee payments and repayments or prepayments would need to be included in the pricing and the buyer not being yet the lender of record, will not be notified by the loan agent about them.

Recurring fees that are included in the final price are: delayed compensation, cost of carry and net economic benefit.

1. Delayed compensation is a fee paid by the seller to the buyer so that there is no party that gains any advantage when the settlement comes late. Up from the expected settlement date till the actual settlement date this fee will accrue as per the current drawings present at the time in the tranche or tranches traded. For example if the trade was to settle on September 30th and the tranche has weekly renewable contracts, with one month of delay for the actual settlement we will have 4 different contracts accruing the delayed compensation fee. The calculation of the fee has to take into consideration any position changes that have occurred at the time as repayments and PIK increases.

2. Cost of carry is a fee paid by the buyer to the seller for the delay in settlement to compensate the seller for time of not having the funds paid from the trade already at expected settlement date. The amount paid is calculated using the number of days between expected settlement date and the actual settlement date and the average daily rate for index of the principal currency of the trade, USD Libor in case of dollars, Euribor for Euro trades etc. Currently, because of the negative Euribor rates, the direction of the fee changes and the fee is paid by the seller to the buyer when trading in Euro.

3. Net economic benefit is a compensation paid by the seller to the buyer for any repayments that took place between the trade date and settlement date. If the seller being the existing lender is repaid by the issuer, the traded amount will be amended to discount the value paid, but also the buyer will be paid the net economic benefit as a compensation. This fee is calculated by multiplication of the traded amount with the repayment discounted by 1 minus price.

Any other fees that are paid to the seller by the issuer of the debt, like amendment or consent fees will need to be proportionally included in the trade since after settlement date they should already have belonged to the buyer of the position. The construction of the final price will include the initially agreed price, any repayments that occurred, all the recurring fees, other fees and transfer fee. What is important is the fact that this fees will usually exist only in secondary market. Primary trades normally settle with the final price being the traded amount, but in some cases the issuer can offer the investors OID fee (Original Issue Discount fee) as a way of encouraging the lender to invest in the loan.

Types of trades

1. Regular secondary par trade - a regular trade in which one party agrees to sell their position in a loan to the other party. The ownership passes on settlement date to the buyer which becomes current lender of record what is called novation. Par trade settle with a price above 85% what means that the issuer of the loan is in a good financial position and the likelihood of them not paying the interest to the investor is relatively small.

2. Secondary distressed trade – a trade that settles below 85% price in loans that are either discounted (the issuer pays less than they should due to financial problems they are facing) or defaulted (the issuer does not currently pay any interest due to serious financial problems). The securities traded as distressed have really high probability of never being paid back, but also the rating agencies evaluating their financial condition give them recovery rates that estimate the likelihood of the issuer getting back on track with interest payments.

3. Combined trades – if any additional trade does not delay the settlement of the first trade, two or more trades with different trade dates can be combined and settle together on the same settlement date.

4. Bilateral netting agreements – are groups of two or more trades that regardless of their trade dates settle together on the same date netting against each other. It is a common occurrence on the secondary market to settle a sale and purchase with the same counterparty, what results in no exchange of ownership if the traded amounts of both trades are equal. In cases like this, the settlement occurs with final prices being net off and the resulting amount is paid either by original buyer or by original seller depending on the timing and fees accruals. Since the position does not change the owner, there is no transfer fee paid to the agent.

5. Multilateral netting agreements – are groups of two or more trades settling together with 3 or more parties involved. The party A – original seller – sells the position to party B that then sells the position to the party C – the final buyer. Since all these trades settle on the same day, from the perspective of the loan agent who is the record keeper, the position changes the owner only once, passing from original seller to the final buyer. Taking that into consideration, only one transfer fee is paid that can be divided between three parties taking part in the transaction.

6. Sub-participation – the buyer is taking a participating interest in the existing lender´s position. This lender remains the official owner of the loan but with the participant owning risk and reward to the amount purchased. These trades rarely have any sort of fees involved since normally these kind of trade is disclosed neither to borrower nor to the agent. Being the official lender of record, the seller will be paid interest and principal by the loan agent on behalf of the issuer but this payments will need to be proportionally shared with the participant depending on their position. Main reasons for these type of investment to be made by the participant are tax related.

Trading will entail signing by all the parties participating a relevant documentation for each and single trade. For trades settling on primary or secondary market regulated by LMA these documents are: Pricing Letter and Transfer Certificate. Pricing Letter would be the main document of the trade and would specify all the agreed upon conditions but principally the amount traded, the price, the currency and settlement date on which the position will change the owner. Pricing Letter will in most of the cases provide funding information in terms of rates and accrual period for the current contracts in the tranches purchased. Pricing Letter will be agreed and signed by both buyer and the seller. The LSTA counterpart of this document is Funding Memo. Unlike LMA trades, the LSTA ones will settle mostly using documentation provided by ClearPar, a third vendor provider that specializes offers more efficient way of generating trade documents. As opposed to more traditional printing-signing-scanning-sending way, ClearPar enables both parties to review the document and digitally

sign it. Transfer certificate is a simple document signed by seller, buyer and in most of the cases loan agent, proving the transfer of position ownership. In this document the seller transfers all the right under a loan to the new lender. The LSTA counterpart for this document is Assignment and Assumption Agreement. The initial deal will be agreed between Traders of each player on both primary and secondary market, but the transaction will then be closed by Closers who will be responsible for preparation of the documentation and all following steps up till the settlement date on which the securities will be exchange for cash.

Most typical investors in the syndicated loans are:

1. Commercial banks

2. Investment banks – financial intermediaries offering to their clients a variety of different financial services. They specialize in complex and usually large in size financial transactions or act as financial advisors for institutional clients. The examples of major investment banks are Barclays, Goldman Sachs, Deutche Bank, Bank of America, JP Morgan, Morgan Stanley just to name a few.

3. Pension funds – funds that function with a base of a benefit plan that is supported by a pool of contributions from various groups like for example employee, organizations, associations or unions. They are usually managed by fund managers and run by a specialized financial intermediary, pension funds can be made up of vast amounts of capital.

4. Hedge funds – funds which serve as an alternative form of investment, that using the pooled funds are managed to use various types of instruments in order to get high returns for their investors.

5. CDOs (Collateralized Debt Obligations) – an example of structured financial instruments that are backed by pool of assets – mainly loans but also bonds, swaps, mortgages etc. – that serve as their collateral. CDO organized into different tranches – notes – that offer different levels of profit at different levels of risk. The periodical payments of interest are paid to the noteholders according to the defined sequence called waterfall.

6. CLOs (Collateralized Loan Obligations) – really similar to the CDOs except for the fact that syndicated loans are the only underlying asset backing the instrument.

2. APPLICATIONS AND TECHNOLOGY INVOLVED

2.1. APPLICATIONS

Scout Portfolio Management is a system used by BNP Paribas Securities Services in London and Lisbon for Loan Administration and back-office services, which is provided by third party vendor. Scout PM is a web-based application offering the possibility to track all the steps of lifecycle of all types of financial instruments from the idea through settlement and up to their following administration. Some of the functional features offered by Scout for loans include:

1. Tracking loans at the credit agreement, tranche and contract level allowing the users to update the information to accommodate all corporate events occurring throughout the life of the loan;
2. Calculating fees (delayed compensation, cost of carry etc.) with the possibility to verify the exact formulas used for their calculation;
3. Generation of all kinds of documentation for both par and distressed LMA/LSTA trades documents such as pricing letters, funding memos etc.
4. Utilization of multiple loan pricing data sources like Thomson Reuters LPC or Markit among others for monitoring of pricing grids;
5. Linking of either internal or third party feeds directly into Scout PM for loan administration tasks processing;
6. Cash reconciliation and reporting services permitting the user to extract detailed or overall reports.

Scout PM is provided to BNPP SS in both production and staging environment. Staging environment that contains a copy of production data, allows the users to perform various tests in order to implement fail-safe solutions in the production environment.

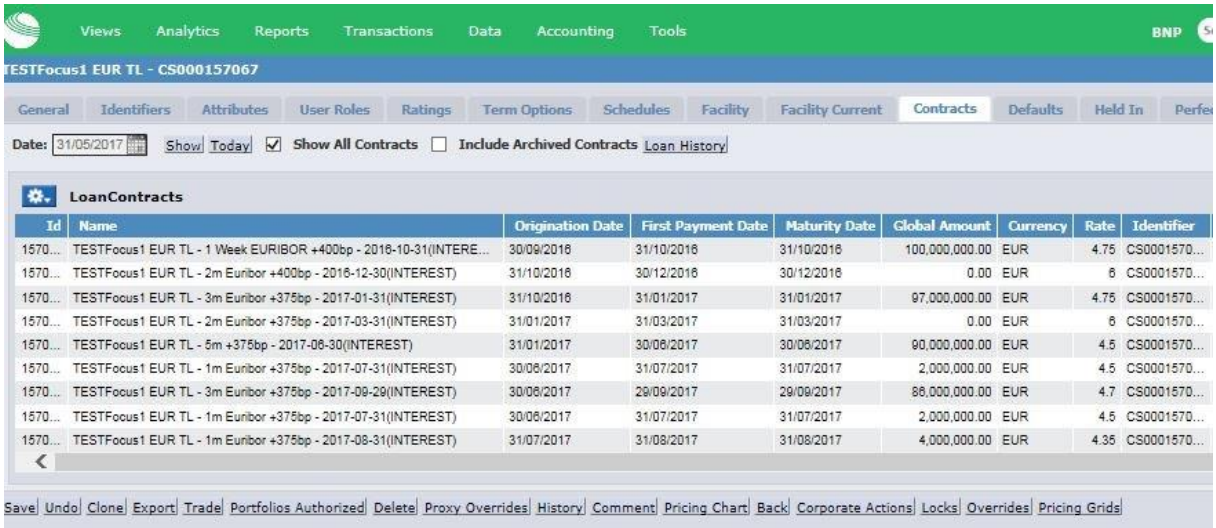
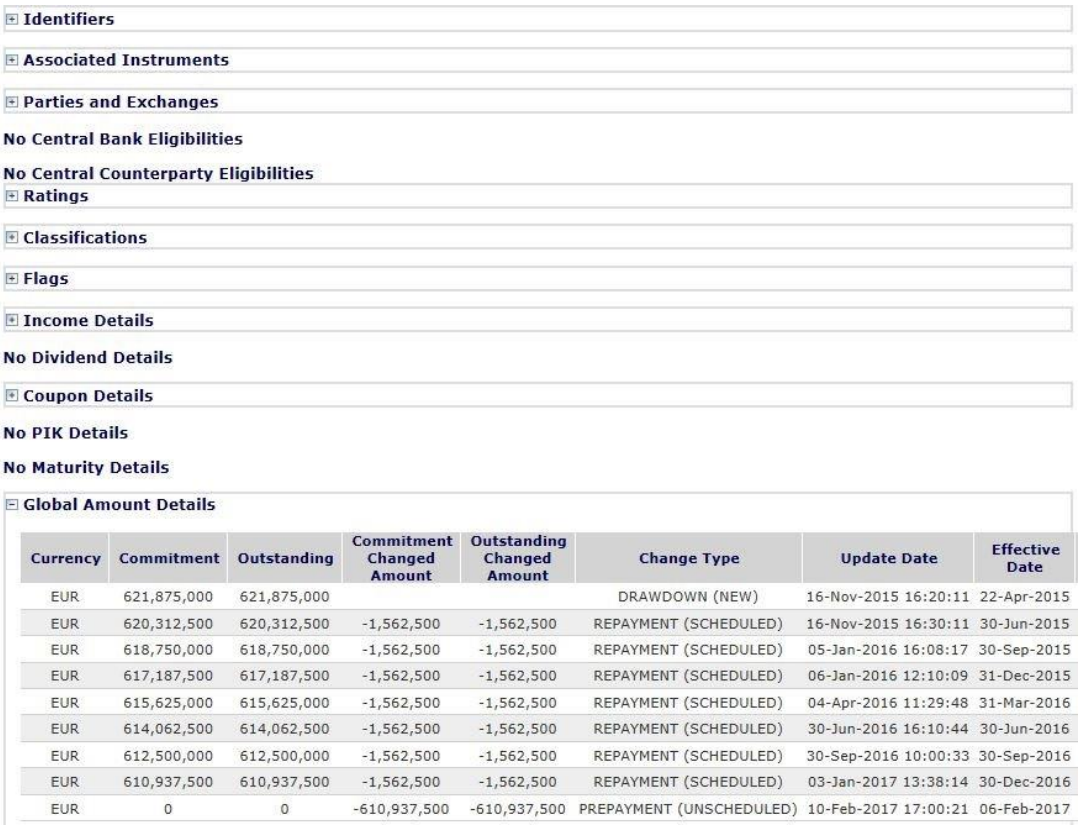


Figure 2.1 – Scout, contracts view of a test security

Nevada is an in-house web-based securities referential system created in an initiative started in 2009 that aimed to create a common repository of data on various types of securities replacing information scattered among various repositories existing in BNP Paribas. Nevada staging environment is used for internal functional testing, but also integration and regression testing with other systems. Nevada due to very simplistic interface is easily connectable to other platforms and terminals like for example Bloomberg which is one of the biggest source for financial information on the securities existing in Nevada.



Identifiers

Associated Instruments

Parties and Exchanges

No Central Bank Eligibilities

No Central Counterparty Eligibilities

Ratings

Classifications

Flags

Income Details

No Dividend Details

Coupon Details

No PIK Details

No Maturity Details

Global Amount Details

Currency	Commitment	Outstanding	Commitment Changed Amount	Outstanding Changed Amount	Change Type	Update Date	Effective Date
EUR	621,875,000	621,875,000			DRAWDOWN (NEW)	16-Nov-2015 16:20:11	22-Apr-2015
EUR	620,312,500	620,312,500	-1,562,500	-1,562,500	REPAYMENT (SCHEDULED)	16-Nov-2015 16:30:11	30-Jun-2015
EUR	618,750,000	618,750,000	-1,562,500	-1,562,500	REPAYMENT (SCHEDULED)	05-Jan-2016 16:08:17	30-Sep-2015
EUR	617,187,500	617,187,500	-1,562,500	-1,562,500	REPAYMENT (SCHEDULED)	06-Jan-2016 12:10:09	31-Dec-2015
EUR	615,625,000	615,625,000	-1,562,500	-1,562,500	REPAYMENT (SCHEDULED)	04-Apr-2016 11:29:48	31-Mar-2016
EUR	614,062,500	614,062,500	-1,562,500	-1,562,500	REPAYMENT (SCHEDULED)	30-Jun-2016 16:10:44	30-Jun-2016
EUR	612,500,000	612,500,000	-1,562,500	-1,562,500	REPAYMENT (SCHEDULED)	30-Sep-2016 10:00:33	30-Sep-2016
EUR	610,937,500	610,937,500	-1,562,500	-1,562,500	REPAYMENT (SCHEDULED)	03-Jan-2017 13:38:14	30-Dec-2016
EUR	0	0	-610,937,500	-610,937,500	PREPAYMENT (UNSCHEDULED)	10-Feb-2017 17:00:21	06-Feb-2017

Figure 2.2 – Nevada, global amortization schedule

MOON is a BNP Paribas multi-product application that automates the capture of Interest Rate Derivatives (high range of financial instruments which value can increase or decrease, with the fluctuations being linked to interest rates) business from the front office traders and manages its workflow through the middle office and on to various operations systems. The core component of MOON is middle office blotter that manages the workflow between marketers, traders and middle office in terms of input and validation of deals. It provides necessary mechanisms to manage the processing of trades into other operational systems, but also supplies controls for this management. The other relevant components of MOON are Trader and Marketer in-trays. Trader in-tray enables the marketers and traders to manage the workflow and distribute the trades between each other and the Marketer in-tray enables them to input and display all the details of a trade. MOON is the applications used in BNPP CIB.

ClientRef is a platform created and used internally in BNP Paribas for client referential purposes.

Bloomberg is major provider of real-time financial information in terms of current and historic financials data, price data and more. The key product of Bloomberg as well as the most well-known

service is Bloomberg Terminal, an integrated platform streaming various types of financial data to thousands of customers worldwide.

STATREC report is a report created for reconciliation between Scout and Nevada systems in the matter of mismatches and discrepancies between both systems. STATREC report compares static-data in Scout with the same data contained in Nevada and marks the breaking points. STATREC report was designed to assist the users of both Nevada and Scout in ensuring the data in both systems is matching and to flag any integration issues that might have occurred when the stream of information was sent from Scout to Nevada.

PNLREC report is a report generated from Scout that is then cross-checked against the information in MOON. The report is generated for accounting purposes and profit and loss calculation.

2.1.1. Application architecture

The architecture of the whole project is built on a constant flow of information between the applications that are used to construct it with Scout being the golden source for security data meaning that any updates to the securities need to come directly from Scout and MOON being the golden source for trade data, meaning that in Scout no economical amendments can be performed on the trades. Scout receives the trades from MOON and integrates them. The architecture ensures that the information inserted in Scout, during the process of the loan servicing or administration, is passed to securities referential, Nevada. The information on the loan or any corporate events that might have occurred are integrated in Nevada. Following that Nevada sends the information to MOON that upon interpretation is reflected on all the trades for the security concerned. This amendments pass from MOON to Scout where a new version of the trade is received. The connection between the systems is permitted thanks to Nevada Identifiers that are shared by all the systems. Each security has Ids at three levels described before - credit agreement, tranche and contract. Updates performed in Scout at any of these levels generate an XML message to be sent to Nevada, which then also with the use of XML message updates MOON.

This architecture can be represented as below:

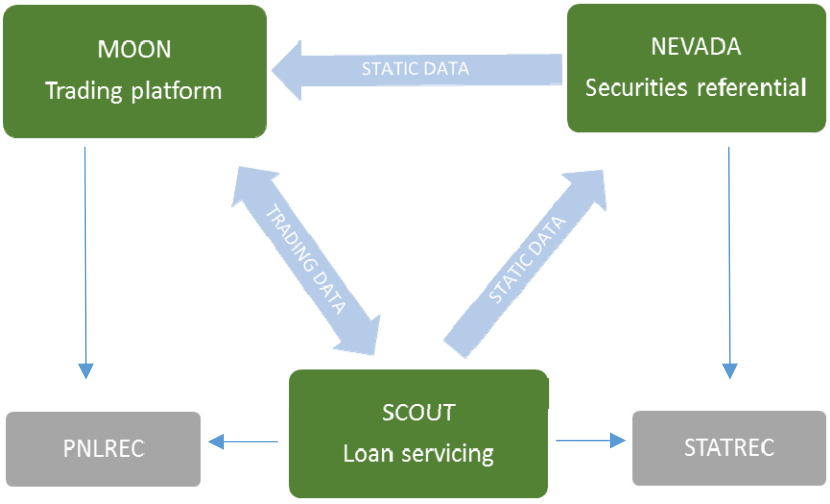


Figure 2.3 – Application Architecture

2.1.2. Connections

The connection between MOON and Scout is bilateral, allowing both applications to communicate efficiently in terms of trading. Any eligible version of the trade is sent from MOON to Scout which sends back a response in the form of one of four messages.

- OK – the purpose of the OK message is for Scout to acknowledge that it has received a valid trade message from MOON. During 6 minutes limit from sending the message from MOON, a response would need to be received from Scout. If no response is received in the permitted interval, an alert would be raised to prompt an investigation team to check the cause of non-receipt. The trade will remain in "waiting to be exported" status of the workflow.
- NOK (Not OK) – the purpose of the NOK message is for Scout to acknowledge that it has received an invalid trade message from MOON. This will be as well a reason for the investigation team to find the cause of sending incorrect message to Scout. The trade in question would wait in "waiting to be exported" status as well while to root cause can be identified.
- ACK (Positive Acknowledgment) – the purpose of the ACK is an update to processing status of the trade in MOON, which in turn determines the behaviour and appearance of the trade in the blotter, in this case to determine by status and colour to the MOON user that the version of the trade has been processed successfully. For example in a case of multi-drawing trades or multi-counterparty trade in which one of the drawings or one of the counterparties are missing in Scout, the trade will be set to pending status till the missing data is created. Nonetheless the ACK message will be send to MOON.
- NACK (Negative Acknowledgement) – Analogically to the ACK message, the purpose of the NACK message is for Scout to update the processing status of the trade in MOON. In this case the message provide MOON user with information that the trade was not successfully processed in Scout and it needs amendments or corrections in MOON.

As mentioned before the connections between various systems are permitted by the use of various identifiers.

1. Nevada IDs – utilized in all of the 3 systems involved are inserted at Credit Agreement (parent Nevada ID), Tranche (Nevada ID) and each drawing / contract if multiple exist (child Nevada ID). All of the applications involved require for the security architecture to be: a tranche, created under a specific credit agreement, a contract created under specific tranche. One credit agreement as in reality can have various tranches associated and various drawings can exist in a single tranche depending on the borrower of debt and their desire of organization of the loan issued.
2. Scout IDs – auto-generated in Scout upon creation of any security (CA, Tranche, Drawing). Scout IDs are sent to Nevada to permit better identification of the data between the systems. To avoid data conflicts each Scout ID can be associated with only one Nevada.

3. ClientRef code – connecting all 3 systems involved to client referential system that eliminates the possibility of trading with any entity that is not present in the internal database, meaning there is no sufficient information on that party what according to KYC policies should be avoided at all cost.
4. Bloomberg ID – connecting Nevada to Bloomberg terminal and allowing feed of financial information (effective and maturity dates, pricing, other identifiers, rates)

2.2. TECHNOLOGY

Below it is included a brief description of the main technology that is utilized in the project or in the applications that are used for its realization.

2.2.1. XML message

XML (Extensible Markup Language) is a format of language that can be read by various types of hardware and software, created by the W3C, as an attempt of overcoming the limitations of the HTML language. XML contains bank of data, organized in a hierarchical way that utilizes tags as a mean of separation of various types of information making it easily read by not only computer systems but human as well. XML messaging provides a powerful, yet flexible infrastructure that permits communication between various software agents and facilitates design of complex schemas. Due to its simplicity, the XML messages allow quick processing that can occur in a matter of seconds, what renders it perfect for architectures requiring almost an instant reaction and integration of data in various systems. In the project presented, the XML messages are used as a mean of communication between 3 applications involved. Scout sends XML messages at each level of the security, meaning that at least 3 messages are sent: credit agreement message, tranche message and one or more contract messages. MOON is fed by XML messaging that comes from Nevada. And finally there is a mutual exchange of XML message between MOON and Scout with each creation of a trade or amendments that can possibly follow. The tree application, no matter how different in their purpose, functionality and interface, are connected together thanks to the technology provided by XML messages.

2.2.2. SQL language

Structured Query Language – SQL – a language first created in 1970s was designed for manipulation, definition, control, processing and consulting a database. Used for relational models, SQL is an interactive and intuitive programming language allowing the users not only to retrieve and manage data in the database but also to change and transform with the aim of getting as much information from the raw data. Some of the most important parts of the SQL language are expressions – that can produce values or even the whole tables that would contain data in various columns and rows; statements – used for control and management of transactions, data flow and connections; and queries – used for retrieving the parts of the databased with the selected by user criteria

constraining and limiting the search. Scout is an application used in the project that is created mostly, but not exclusively with SQL language.

2.2.3. HTML language

Hypertext Markup Language – HTLM – is a language mainly used for creation of webpages but also for control and management of their content and functionalities. The structure of HTML built with elements that can be embedded into the webpage such as images, videos, forms. The language provides the user with ways to design the structure of the document as well including headings, lists, paragraphs and others. The elements of HTML are composed of tags, written with the use of angle brackets that are not displayed by the browser, which interprets the HTML itself and presents the content of the document to the user in a way designed by the programmer. Both Scout and Nevada are web-based application applications.

3. EXECUTION OF THE PROJECT

The project, considering its scale and purpose, was carefully planned and thought through to include necessary deadlines, check-up points with results verification, possible delays and resolution of any issues that could occur. The project was divided in 3 main parts that are further divided for design of a detailed and structured plan that could be used as a reference and guide at any point of its completion. The first part of preparation and creation of workflows and processes was the longest part, taking almost one year to complete. The second phase included testing of the solutions designed and verification of the results. The last phase was implementation of these solutions – with any amendments and improvements that were the outcome of the testing phase – in production and necessary follow u and control of their functionality. Below it is included the chronogram of the project, edited to include real information and not the initial plan.

		2015								2016												2017					
Phases	Activities	MAI	JUN	JUL	AGO	SET	OUT	NOV	DEZ	JAN	FEV	MAR	ABR	MAI	JUN	JUL	AGO	SET	OUT	SET	NOV	DEZ	JAN	FEV	MAR	ABR	MAI	JUN
1	Design of processes, procedures and workflows																											
	Analysis of possibilities and limitations of the applications involved																											
	Data preparation in all systems involved																											
2	Logical Day 1 of Testing phase																											
	Validation and reconciliation of the result of LD1																											
	Logical Day 2 of Testing phase																											
	Validation and reconciliation of the result of LD1																											
	Logical Day 1 of Testing phase																											
	Validation and reconciliation of the result of LD3																											
	Summary of the results and development of the improved solutions																											
3	Redesign of the processes, procedures and workflows																											
	Implementation of the solutions in production and follow-up																											

Tabela 1.1 – Chronogram of the project

3.1. PHASES OF THE PROJECT

3.1.1. Preparation and design of processes

The workflow of information and design of each process was made upon careful analysis of the desired results and capabilities and limitation of all the systems involved. In many cases there existed issues and challenges that had to be overcome in order to make the infrastructure work properly. While these processes were established, a documental support was created as well in the form of procedures that could not only serve the purpose of guiding the user inserting the information in any of the systems but also as a mean of controlling the consistency of this input. Before any further steps the information stored in Scout for the instrument that would be utilized had to be prepared to assure that when the connection to other systems would be set up, the data would integrate smoothly without any issues. A list of instruments to be tested was created and each and single one of them had to either undergo all the necessary verification of their quality or be created from the scratch in Scout if previously non-existent. With these checks complete, a copy of the production data was replicated in the staging environment where the testing phase would commence.

3.1.2. Testing

A detailed test plan was created that meticulously described each case in terms of purpose, necessary steps and teams involved in taking them, expected results and their validation. The testing phase that lasted a couple of weeks was divided data-wise into 3 logical days, with different types of tests designed for each of the days. For example on a date before the logical day 1 the trades would be instructed and sent down to Scout were it would be received and settled on logical day 1 with the fees accrued, then the asset servicing part would start with the interest calculation and a repayment event processed on logical day 2 just to be followed by the sale of the position that would settle on logical day 3. Each case included in the plan would test a different set of trades and events, exhausting all the possible scenarios that can happen in reality. The results were collected and validated after each logical day and reconciliation was performed between each of the systems to assure that no discrepancies were found. Only upon confirmation that after the events of logical day 1 all the systems were in line and the desired outcomes were achieved, the logical day 2 could begin. The testing phase was as well a time for each of the teams involved to communicate and cooperate with each other, learning the functionalities of other systems and getting training necessary for the future processing on daily basis. During this phase, some of issues were identified and investigated where the data wouldn´t be correctly integrated or the desired results were not achieved. These needed either developments of new functionalities, modification of the existing ones and or workarounds allowing to secure satisfying outcomes.

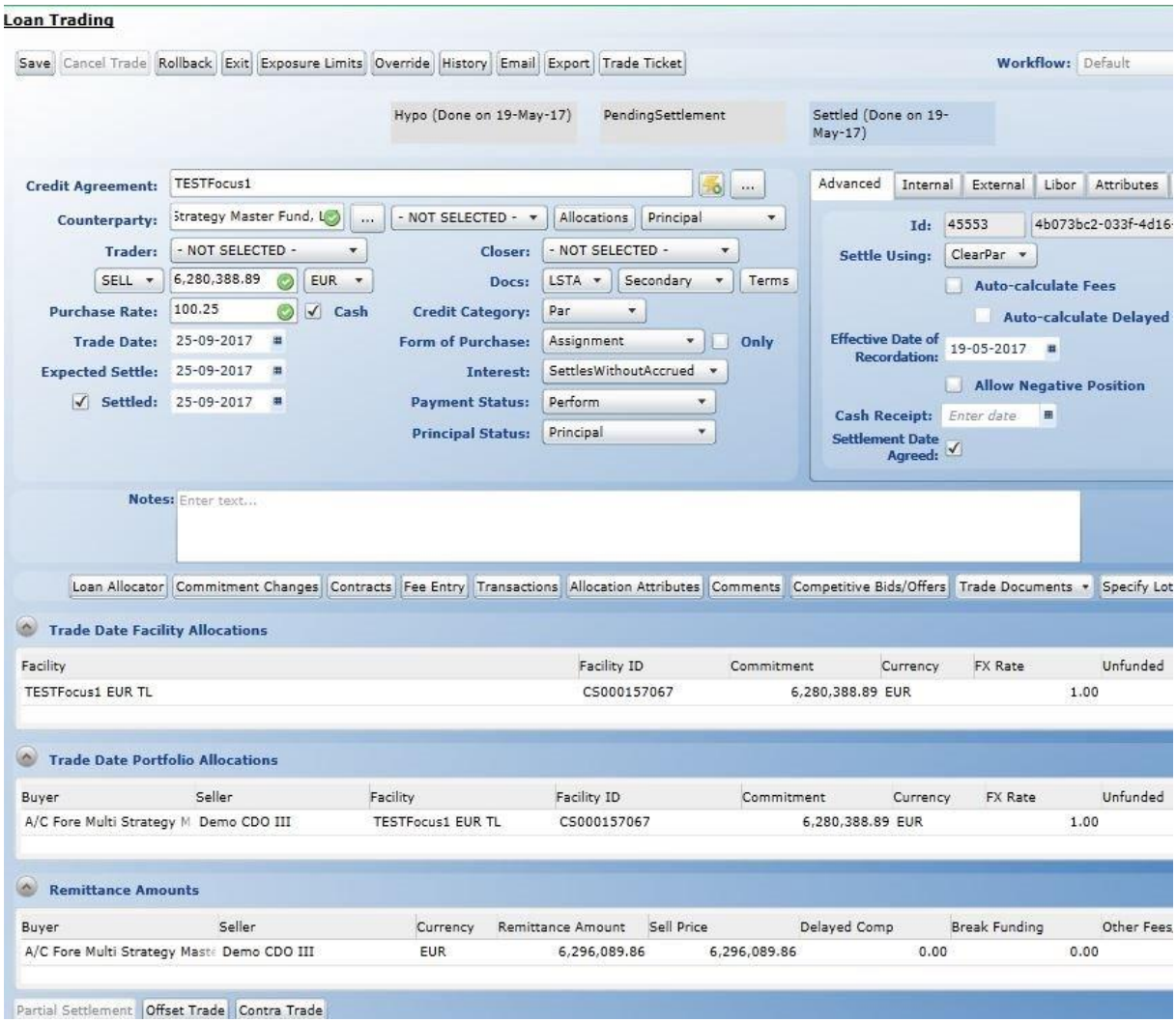


Figure 3.1 – Example of a test trade in Scout

3.1.3. Production

The last phase that followed successful testing of all the essential test cases, what proved the infrastructure and XML messages designed work properly and that the systems are prepared for the activity to start. This phase is still ongoing with the business as usual daily work of using the infrastructure for trading activity and subsequent loan servicing. The reality proved, that not all of the possible scenarios were tested and new challenges appeared, appear and will continue to appear in the future with new, untested situations to be processed. This includes the incorrect input or processing errors in either one of the systems causing some discrepancies or breaks that are not that easy to resolve. In many cases these require proper investigation and search for solutions that would fix the issue, including cancelations, amendments and unfortunately in some of them re-creation of the instrument and re-initiation of the whole workflow.

3.2. CHALLENGES

3.2.1. Data inconsistence and quality

Other clients using Scout do not require loads of information considered essential for project X. The users updating the system of records were used to update it with not so many restrictions and additional data and while it does not really matter for the loans in which these other clients have positions but there is no position of BNPP London Branch (the connection to Nevada is not created) it does matter in the shared loans, where the position of BNPP London Branch exists along the positions of other clients. These loans, updated not only by the users involved in project X, but practically any Scout user, require for the data to be completely correct and not only at financial level, but also at the static data level and connection to other systems Nevada and MOON. The training provided to all the users was in many cases not enough to win over bad habits learned over months or even years of updating the system without many of the introduced constraints. For example, the global commitment schedule that displays any changes at global tranche level that occur throughout the life of a loan needs to be filled in with not only correct values of the paydowns or repayments that take place but also include appropriate change types and the first entry in the schedule needs to match in date the first contract ever inserted for this loan. Another example could be attributes or identifiers that have to necessarily be inserted in Scout to ensure correct integration of the information in Nevada while the XML messages are sent. These and many more requirements took a long while for the users to get used to and it was necessary for users involved in the project not only to train the rest of the users but also to educate them and present them with more complex and in fact more correct ways of input.

3.2.2. Slight systems incompatibilities

The systems utilized were designed in their own way and functioned that was fulfilling their purpose before the project was introduced. There exists many small differences in which certain events are processed in each systems and sometimes additional solutions and workaround were necessary to overcome these differences. Nevada was created as a repository for conventional debt instruments like bonds, which hardly ever change their structure and pay regular coupons that are accrued with an unchanging interest rate. These instruments do not have many of the events that occur in a syndicated loan like paydowns or splits and combines. In the phase of testing while implementing the project, workaround needed to be found to update Scout in a way that would allow the XML message to be integrated in Nevada correctly. Unfortunately many of these include manual amendments in Nevada what goes against the rule of Scout being the golden source of the static information, but in these cases due to incompatibility of Nevada there is no other solution available. Another example is a spread change that while processed in Scout at tranche level and affecting all of the loans contracts, is processed at contract level in Nevada and needs to be reapplied manually in case of multiple drawings present in the certain loan.

3.2.3. Developments and upgrades required for Scout

Similar incompatibility issues would occur between Scout and MOON but with trading functionality. In many cases a certain fee would be calculated in a slightly different way in MOON than in Scout requiring manual amendments. In other cases both systems would in turn process certain events in a completely different way what would cause financial discrepancies between them. In this case an example could be a trade in a loan that between trade and settlement dates suffered from a total repayment and practically the only thing settling and being paid are recurring fees. These kind of issues unfortunately couldn´t have been fixed by alterations in input as the issue lays in the systems functionality and the ways of processing. The only solutions were developments and upgrades to the applications that amended these functionalities and permitted both Scout and MOON to be in line in terms of the technical but also financial data.

3.2.4. Cooperation and understanding of the process

This new and innovative project was released in cooperation of many various teams that have never worked together and in some of the cases that have never worked with syndicated loans before. The setup of the infrastructure and its design required coordination of various systems what would not be possible without a thorough analysis of each system´s capabilities and even more importantly – their limitations. The phase of testing that occurred before the going live of the project included a really important part which was the mutual training and education between the participating teams in the aspect of learning about the challenges and the procedures used. Not having access to Scout, the Nevada users would need to understand the problem at hand in their system through the eyes of Scout user who sends the XML message. Multiple times it was necessary to organize phone conferences involving all the participating parties to deal with the problem at hand that depends on the processing in all systems utilized. The understanding of the whole workflow at operational level was essential for the flow of date to go according to the plan designed at technical level. This process of continuous learning carried on and still carries on in production, after the testing phase, with new issues and new problems appearing on daily basis.

3.3. SOLUTIONS DEVELOPED

3.3.1. Rejected and missing static data notifications

The control of information that was missing and incorrectly integrated could not have been done manually after each amendment in Scout at static data level or in MOON at the trading level. These notifications were developed to allow Scout users to correct the information that was not properly integrated in Nevada and input information that was missing when the trades are sent down from MOON. Rejected data notification is an e-mail notification received by Scout user when information is inconsistent, incomplete, incorrect or missing after sending the XML message to Nevada. The monitor designed for this notification would perform a check of the integration of the message sent from Scout. In case of any discrepancies regarding the basic requirements for the message to include, the message will continue to be rejected by Nevada until the information is corrected. These requirements are for example: updated schedule, correct instrument type, correct issuer and

borrower organizational roles, matching effective and maturity dates of tranche, credit agreement and the present contract, correct spread, matching attributes and identifiers to name a few. This notification allows Scout user to perform necessary amendments to have the XML message integrated correctly in Nevada and for Nevada to pass necessary parts of this information to MOON which would represent them in the trade that then is sent down to Scout. Missing static data notification would be received if information included in the trade sent from MOON does not exist or is not correctly identified in Scout. For example: any trades that would be instructed against tranches that do not exist in Scout, any missing present contracts, missing counterparties would generate this report to prompt Scout user to either create the missing data or to link the existing data using Nevada ID (in case of Credit Agreement, Tranche or Contract) or ClientRef code (in case of a counterparty). The missing static data would not stop the trade from being integrated in Scout, but the integration would be incomplete and the trade would be stuck in the pending status, which does not allow any alterations in Scout, until the missing data is created.

3.3.2. Shell instruments

In many cases the trades have very rudimental information on the loans that they agree to purchase on the trade date. The complete and full information on this instruments is provided by the Seller of the certain position before the settlement. The trades however would need to be instructed right away and kept in the systems for financial purposes (profit and loss calculation). The solution developed is a creation of a shell loan instrument. A shell is a loan created with very basic information that the trader has at trade date and then updated with default information on the rest of the requirements needed to allow flow of information between the systems. The shell would need to exist in every system and then would be updated before the trade settles to ensure no random, incorrect data is recorded for the settled positions.

3.3.3. Dummy portfolio

As discussed previously, the XML message sending would occur only, and only if there would be either a traded (existing trades unsettled) or settled position in Scout. Even if the instrument would be created in Scout and linked to Nevada using Nevada IDs, no message would be sent to Nevada if there would be no open trades or already settled positions present. This renders it impossible to prepare Scout information – in terms of checking for any missing or incorrect data – for any future trades. That also means that in case of a full repayment of the outstanding positions for all the lenders (loan termination or restructure) no message would be sent to Nevada to update it with this event. The solution developed was a creation of a dummy portfolio, that would exist only in Scout and that would be included in the trading portfolios group. If required, there would be a manual input of a fake dummy position in this portfolio, what would force Scout to send the XML message to Nevada. However this portfolio couldn´t be included in the reporting portfolios group, since the fake position couldn´t be counted in and accounted for in the profit and loss calculation.

3.3.4. Rollup template

Developed in a need to overcome differences between Scout and Nevada is a template used for manual amendments required while processing a split or combine. Nevada is unable to process these events correctly and integrate the XML messages in a different way at tranche and drawing level. The information initially sent from Scout needs to be then manually amended in Nevada to match. The template was created to standardize the requests for manual amendments and to clear out any confusion that sometimes might occur if the events are quite complicated.

3.3.5. STATREC report

Designed to permit reconciliation between Nevada and Scout. This report uses and extraction from Scout and then a workflow that compares this information with the data stored in Nevada, flagging for any discrepancies and mismatches. Rejected messages and ones that are not properly integrated or that contain any errors would come up in this report allowing the user to correct the information in Scout by resending amended XML messages.

3.3.6. PNLREC report

Created to serve the dual purpose of reconciliation between MOON and Scout but as well used for accounting purposes in the calculation of profit and loss. The report uses extraction from Scout and matches it against very similar extraction from MOON, looking for any discrepancies or differences between both systems. As for the accounting, it is done on daily basis using the extractions from the previous day that are run in an overnight job. The accounting controls not any transactions that are already created in Scout but also the future, potential transactions that will be posted along settlements or contracts maturities. As for future trade transactions, the fees inserted in the trade will be incrementally growing each day as the gap between the start of their accrual – expected settlement date – and the actual settlement date will be growing. As for interest future transactions, the future projections are made based on the maturity date and the rates to calculate the value that will be paid when the contract matures. The incremental growth of accrued interest, much like the trade fees increase is managed carefully, and clarification or justification needs to be provided always when any sudden, unexpected drop or gain occurs.

4. CONCLUSIONS

Project X, carried out across 3 different locations and involving many different teams and people from various countries, backgrounds and cultures has been the biggest project I have participated in. Being a part of a project realized at this scale has been enriching professionally, but as well in terms of personal development, as it allowed me to put to practice the knowledge I have acquired before through my experience in banking sector but also the recently gained academic knowledge in terms of information management and technical background. It has been much easier for me, in comparison with my colleagues to comprehend many details, including xml messages and software architecture as well as understand at higher level the functioning of our main application Scout that is built using, albeit not exclusively - SQL language. The long weeks of preparation, design of the procedures and processes as well as analysis of the solutions initially developed were followed by the extensive testing phase that allowed to determine the functioning of the whole data workflow. After that came the time for the project to finally come to life and the period of even harder work of dealing with reality, real issues and problems that have arisen from the scenarios previously tested but also from the new untested situations that had to be resolved under time pressure. The beginning of that phase was especially hard considering that the preparation of the date did not envision many factors that played an important role later on.

The project itself was quite demanding from my perspective, because thanks to the workflow that works in a constant loop, the client has an almost immediate visibility of the errors and discrepancies. The reconciliation and correction of errors had to be done on daily basis with some of the errors being discovered along the day, making it possible for the necessary amendments to be applied right after their discovery. The solutions developed in the testing phase, were perfected and modified in production phase to be more resilient and reliable, thanks to the experience acquired while dealing with real cases. The first months were challenging and required loads of extra work, but the effort paid off and made it possible for the teams involved to get on an almost error-free path with practically no processing mistakes and to increased speed of dealing with the issues at hand. This had led to increased client satisfaction and really good feedback. This positive outcome has been an indication for the management that a project´s infrastructure could be applied for future work and extended to more locations.

5. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORKS

Along the way, there has been plenty of developments and modifications to the software that is included in the architecture designed. Some of them, deemed necessary, have already been developed, while others are yet to be dealt with. The incompatibilities between software that existed before, are still present and while for some of them we were able to find workaround allowing us to get the desired results even if with a bit of manual input or alterations, for others the development of the solutions required is too time-consuming and costly. An example in this case could be “trading flat” functionality that in theory allows to trade with no accrued interest being calculated. The developers of MOON and Scout has interpreted this event in a different way, hence the results are different in both applications. For instance, a positions needs to be transferred from one trading portfolio to another. There would need to be booked two internal mirror trades – purchase from portfolio A to B and a sale from portfolio B to A. The situation calls for an exchange with no interest involved hence trading flat. The fact that Scout and MOON interpret this event in a different way leads to discrepancies in the interest calculated what cannot be accepted. While a workaround exists for this particular issue- manual processing in both systems that is not sent down from MOON to Scout or Scout to MOON - the upgrade of one application should be done in order to include this quite common event in usual processing. Due to limited budget, not all of the solutions can be developed and the ways of going around the issues are still in place.

As for the future works, the project developed for UK activity has already thanks to good results, extended to include North America activity and is in the phase of testing. The architecture of software utilized and described in this project, has been replicated and will be used to include trading activity for United States of America and Canada. Using the experience and ready tailor-made solutions that were designed before, it has been incomparably easier to get this expansion to work. The project will include using the same applications and even some of the functionalities and solutions, are shared and include both locations. For others a clear separation has been designed to draw a clear line between them, in terms of accounting for example. Armed with expertise and knowledge acquired in the project described in this work, I am confident in the positive results of the expansion and an active participant of its implementation.

BIBLIOGRAPHY

Adler, A. (2001). An XML messaging architecture for border management systems, *3*, 255–268.

Altunbas, Y. (2011). Why do banks join loan syndications? The case of participant banks, *31*(7), 1063–1074. http://doi.org/10.1080/02642060903100364

Bisbey, A. (2013). LSTA: Annual Loan Volume Seen Reaching $500B. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&site=eds-live&db=bth&AN=90385472 OP - High Yield Report. 9/16/2013, p8-8. 1p.

Fest, G., & Bisbey, A. (2013). Secondary Loan Trading Set for Record. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&site=eds-live&db=bth&AN=92043552 OP - High Yield Report. 11/18/2013, p21-21. 1p.

Gande, A., & Saunders, A. (2012). Are Banks Still Special When There Is a Secondary Market for Loans?, *LXVII*(5), 1649–1685.

Gopalan, R., Nanda, V., & Yerramilli, V. (2011). Does Poor Performance Damage the Reputation of Financial Intermediaries? Evidence, *LXVI*(6), 2083–2121.

Houser, A. R. (2001). Trends in XML Software. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&site=eds-live&db=bth&AN=3989282

Ivashina, B. V., & Scharfstein, D. (2010). Loan Syndication and Credit Cycles, *100*(May), 57–61.

Kamstra, M. J., Roberts, G. S., & Shao, P. E. I. (2014). Does the Secondary Loan Market Reduce Borrowing Costs?, 1139–1181. http://doi.org/10.1093/rof/rft011

Lubell, J. (2001). Architectures in an XML world, *4*, 399–410.

Mohn, E. (2015). SQL (Structured Query Language). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&site=eds-live&db=ers&AN=87322820 OP - Salem Press Encyclopedia of Science, 2015. 2p.

Patwardhan, A., & Patwardhan, R. (2008). XML Entity Architecture for Efficient Software Integration, 4–8.

Qin, Zheng; Xing, Jiankuan; Zheng, X. (2008). Software Architecture. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=edsebk&AN=276305&site=eds-live

Schure, P., Scoones, D., & Gu, Q. (2005). A theory of loan syndication, *2*(3 OP-In Finance Research Letters 2005 2(3):165-172), 165. http://doi.org/10.1016/j.frl.2005.04.002

Strîmbei, C., Dospinescu, O., Strainu, R.-M., & Nistor, A. (2015). Software Architectures – Present and Visions., *19*(4 OP-Informatica Economica. 2015, Vol. 19 Issue 4, p13-27. 15p.), 13. http://doi.org/10.12948/issn14531305/19.4.2015.02

Whittaker, E. (2016). The LMA marks 20 year history and prepares for next test. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&site=eds-live&db=bth&AN=121073347 OP - GlobalCapital. 12/19/2016, p117-117. 1p.