Secure central retail reporting

(SCRR)

Bachelor thesis:
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Abstract

This bachelor thesis presents the findings and conclusions which have been made during a pre-study called "Secure central Retail reporting". The pre-study has been carried through between 2011-05-13 and 2012-03-30 in a global furniture company. The company´s core business is to design, construct, transport and sell affordable solutions for better living and create a better everyday life for the many people. IT is not part of their core business but nevertheless necessary to make it possible to control and manage the logistics, warehouses, retail stores systems and the progress of their vision and goals.

There is a need in the company for a consolidated data source to retrieve data from the retail systems in the stores and a central retail disaster tolerance solution since those are locally installed on store level. There are needs to get business management report information with data covering more than one store or country. To be able to have reports globally or covering more than one country/store, a centralized consolidated data source is needed.

The pre-study showed that the two software technologies could not have benefits from each other, except on an environmental level. The pre-study has put more effort in proving the replication and consolidating of data with the software product JCC LogMiner Loader since this software is not used in the company before.

The pre-study showed that it is possible to implement a solution that covers both the central retail reporting and the disaster tolerance needs together as one solution and the two solutions in two separate parts. The most beneficial is to implement it by sharing environment solution because while this is easier to maintain and support and thereby is cost saving for the company in long term perspective.

Sammanfattning

Denna uppsats presenterar resultaten och slutsatserna som gjordes under förstudien "Secure central retail reporting". Förstudien bedrevs mellan 2011-05-13 and 2012-03-30 för ett globalt möbelföretag. Företagets kärnverksamhet är design, konstruktion, transport. Att sälja prisvärda lösningar för ett bättre liv och att skapa en bättre vardag för de många människorna. IT är inte en del av företagets kärnverksamhet men ändå nödvändigt för att ha kontroll och manövrera logistic, lagerhantering, varuhussystem och framstegen i strävan efter deras vision och mål.

Företaget har ett affärsbehov att se information som täcker mer än ett varuhus eller ett land. För att kunna konsolidera denna information behövs en central konsoliderad datakälla. Företaget har också ett behov av en central katastroftolerant backup-lösning istället för de lokala lösningarna som finns idag.

Förstudien visade att de två mjukvaru-teknologierna inte kunde dra fördel av varandra mer ur ett hårdvaruperspektiv. Förstudien har därför lagt tyngden på utvärderingen av produkten JCC LogMiner Loader för att bevisa att replikering med hjälp av denna produkt fungerar i företagets IT-landskap, då denna produkt ej tidigare använts av företaget.

Förstudien påvisade att det är möjligt att implementera både den centrala rapporteringsdelen och backup-lösningen. Det mest fördelaktiga sättet att implementera den nya lösningen är att bygga en gemensam fysisk miljö då detta kommer att möjliggöra effektivare support och underhåll vilket i längden leder till kostnadsbesparingar för företaget.

Recommendation

The pre-study team recommends the company to implement the both solutions, the central report solution and the Hot Standby solution, at the same time in one project. It is possible to separate parts of the implementation but the pre-study recommend implementing the common infrastructure at the same time (hardware, software, setting up routines, etc.) to decrease the risks with changing in the retail store instances more than once and also save time and resources.

The pre-study team also recommends running a pilot as part of the project since the pre-study is still in the test phase.

List of contents

1 Introduction

The pre-study Secure Central Retail Reporting was initiated by the company due to a critical need of a new solution where it should be possible to replicate data from the retail store systems into one central reporting database and to replicate complete retail store databases for disaster tolerance. The urgent need of such a solution was a result of business users' need of visibility after changes in the retail systems.

The steering committee demanded a prototype based on live test data and replication tests with the proposed technologies JCC LogMiner Loader and Oracle Hot-Standby. Thus the pre-study configured the soft wares and performed tests cases based on the end user needs, performance requirements and network limitations.

1.1 Approach

The thesis consists of the pre-study and this implied that the thesis was executed as a pre-study activity according to the company´s processes with the author as the project manager. The project model Practical Project Steering, PPS has been used throughout the whole pre-study according to recommendations from the company.

1.2 Methodology

This chapter describes how the work has been performed. The methodology approach used for this thesis is based on the company´s result need. The company expected a proof of concept on the proposed system design solution. It should be performed as a pre-study using the project model Practical Project Steering, PPS, and include a benchmark to be able to compare proposed solution with other alternatives. The pre-study should deliver a base for decision document and a presentation to the steering committee. The level of this presentation and material should make it possible to decide the way forward without further investigations.

Thus the work was divided into two methods [see fig 1]:

1. Using case study to evaluate existing proposal by setting up a test environment prototype and measure the results.

2. Perform a literature study comparing other existing solutions to be able to highlight pros and cons analysis.
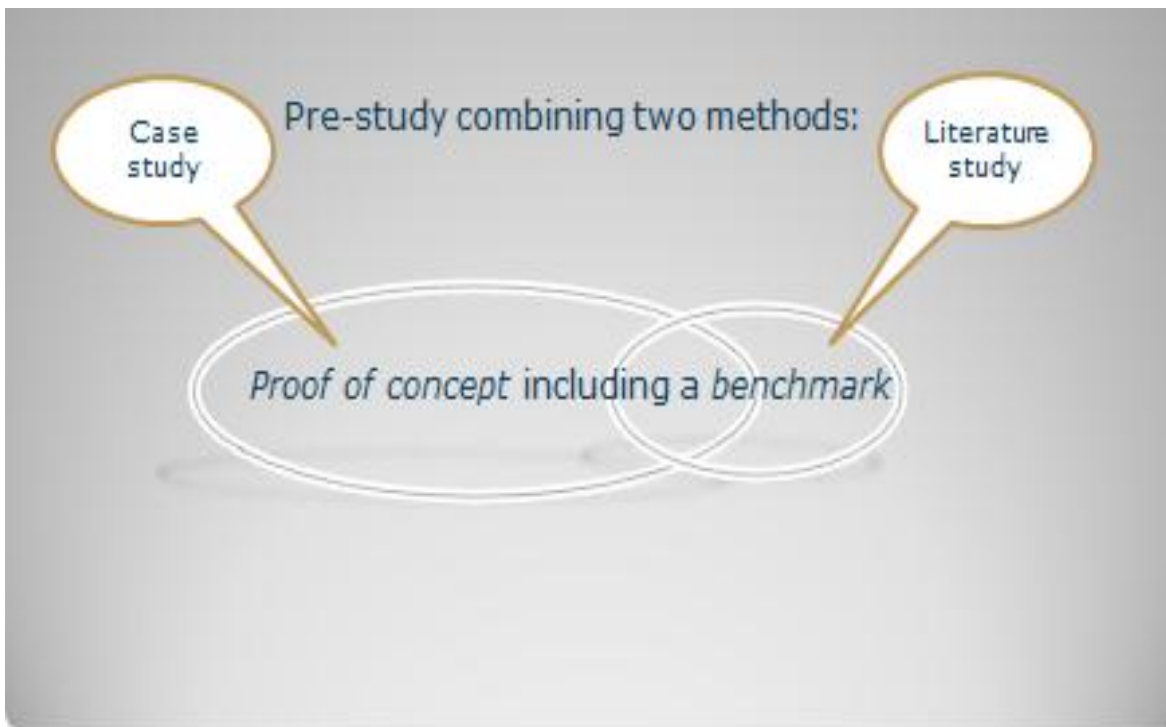
Figure 1: Methods

1.2.1 Case study - Proof of concept
The pre-study team analyzed the impact on the IT landscape in parallel with the potential impact on tasks and responsibility for the support organization, and the readiness to implement the solution. A test environment was configured and JCC consulting Inc. let the company borrow licenses for the JCC LogMiner Loader application. By this the team could configure the application to replicate data from a retail store test system to a central environment and unload and update data. PPS was used as pre-study steering model during the proof of concept.

1.2.2 Literature study
The literature study should give an overview of the existing, already proved, techniques that suitable for the current system environment, from a theoretical point of view. Thus the material was collected directly from product

documentation, articles, application official presentations and dialogs with the application owners. Internet has been an important source to find electronic documentation and articles directly on the application owner´s websites and to get in contact with application experts in the specific area of Oracle RDB and OpenVMS. The literature study resulted in a consequence analyze.

1.3 Analyze

Since the pre-study was divided into two different approaches, two different ways of working were used.

1.3.1 Case study
Why PPS?
The company use [8]PPS and templates as their common project model and therefor the pre-study should be managed by the PPS process [see fig 2].
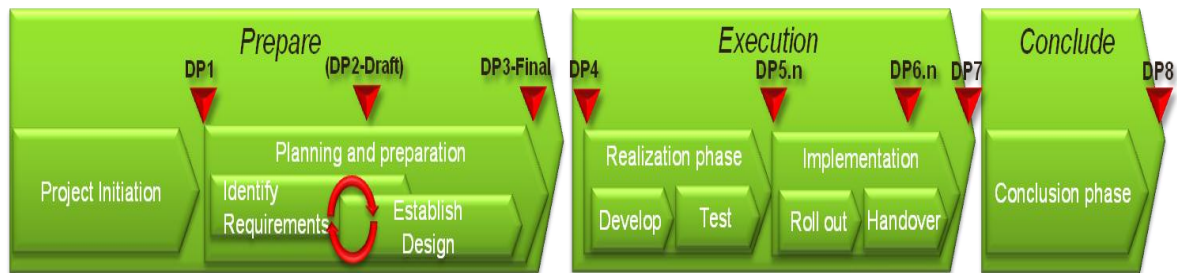
Figure 2: PPS model

The project initiation is in this case the pre-study initiation [see fig 3].
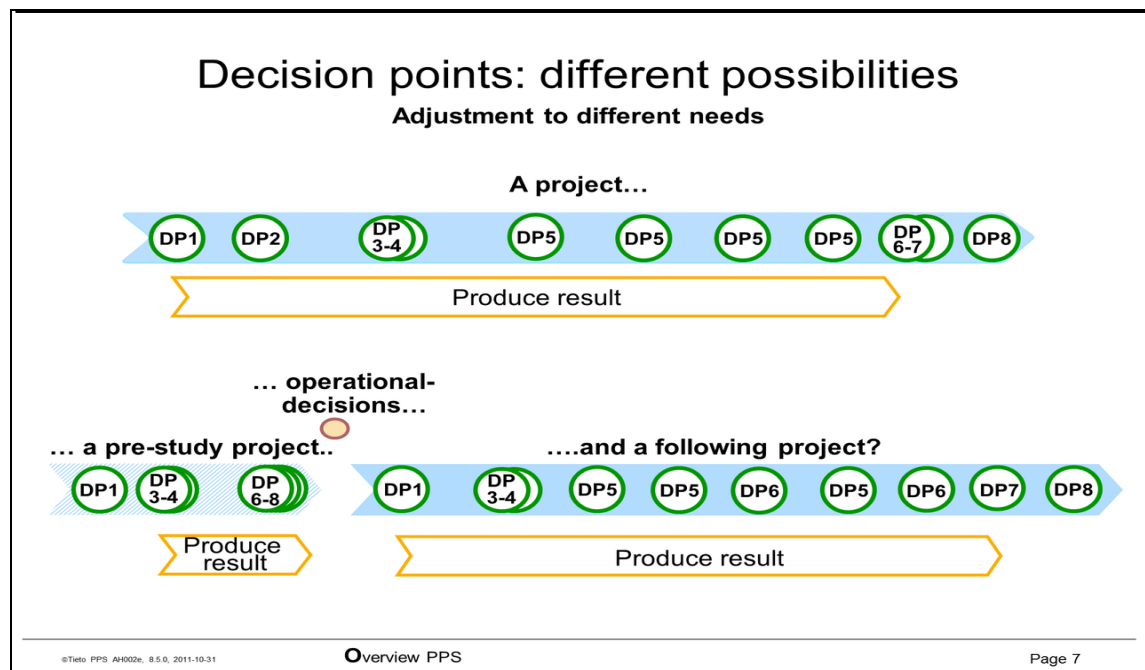
Figure 3: PPS model including pre-study

11

According to [8]Tieto, PPS provides complete support for both large and small projects and has ready-made descriptions. The authors experience after working due to the PPS model is that it was very well suited for this pre-study while it was very well connected to all necessary steps for an IT pre-study and contained all needed document templates to be able to efficiently plan, execute and follow-up the work. What the author missed was the "how to" descriptions. Therefor the author chose to use a complementing book, [11]Project management, as best practice support from a project leader point of view.

The case study started with a work breakdown structure work shop where the detailed activities could be identified [see part of the Gantt schema in table 1]. These activities resulted in a time plan.

Table 1: Detailed activity plan (Gantt schema)

Month	Status	Est.work
Week		
Total		**1 071,0**
Activity plan		
- Time plan, activities, budget, wbs	C	
- Maintenance Proposal SCRR	N	
Risk analysis 1 workshop		
Mini risk ws with MHS, RL and activity members	C	
Risk workshop business+IT	N	
SRP:Collect and prioritize reports SRP pilot in WinGADD		
- Collect reports	C	
- Prioritize reports	C	
Requirement Specification SCRR		
- Collect reports	C	
- Prioritize reports	C	
- Requirement specification, functional	O	
- Requirement specification, non-functional	O	
- Requirement specification, technical	O	
- Create stakeholder list BAT responsible	O	
Proof of Concept part 1		
- Hot-standby and JCC LogMiner Loader: Non-functional tests with initial capacity tests.		
-PoC report		
Activity plan PoC		**0,0**
- Time plan, activities, budget, resources		

-Environment needs and license costs		
Proof of Concept part 2		**406,0**
- Coordinate with SRP pilot rollout schedule.	O	
- Select pilot(s)	O	
- Configure pilot/test environment.	O	16,0
- Prepare Pilot central database for pilots with SQl*NET		24,0
- Create roll back scripts	N	24,0
- Create implementation scripts		80,0
- create Start and Stop routines Hot Standby/JCC	O	138,0
- create/modify backup scripts		48,0
- create monitor routines för Pilot		12,0
- create stakeholder list BAT responsible	O	
- Establish contact Wingadd	N	4,0
- Establish contact with IBM Cognos	N	4,0
- License, upgrades and support	C	
- PoC report	O	40,0
- Test Cognos 8.4 connection		8,0
- Test SRP report 0001 in Cognos 8.4 with IBM		
- Test GADD.net connection with Elisa	O	8,0
- Test SRP report 0001 in GADD.net	O	
Order hardware		**16,0**
- Update OpAM and send for approval to EAB (1 PTE, CTE - 2 PPE PROD)	O	
- Write GPA light	O	
- Write IR	O	16,0
Implement Hot Standby - LogMiner solution		**83,0**
- Test Back up	N	
- License, upgrades and support	N	24,0
- Development	N	
- Test plan light SCRR	N	16,0
- Test specification SCRR	N	24,0
- Test specification GADD.net	N	
- BAT GADD.net report 0001	N	
-Preinstalltion Pilots		16,0

A part of the high level time plan [see fig 5] with general activities is presented as a staple diagram which makes it easy and user friendly to present the status and time line to the steering committee and other stakeholders. "M" is an abbreviation for milestone.

The pre-study team consisted of both off-shore and on-site resources and thereby most of the meetings were set up as live meetings via the WEB. The author had the role as pre-study leader [see fig 4] and worked closed together with developer, tester, product responsible and system specialist in the same location. Due to time line constraints this was according to the author the most efficient way of setting up the team.

SCRR pre-study: Organization schema
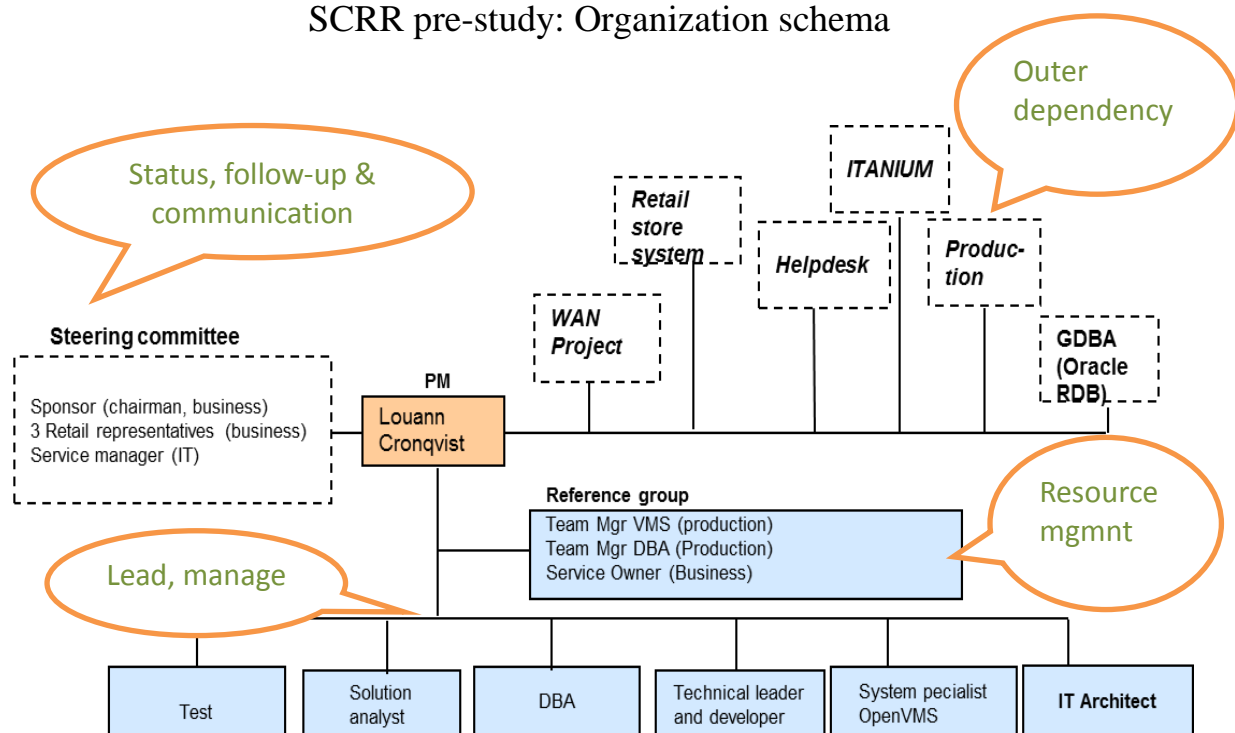
Figure 4: SCRR pre-study organization schema

As the pre-study leader the author had overall responsibility to manage the pre-study as a in the role of a project manager. Examples of activities are budget, planning, facilitate weekly meetings, follow-up, presenting status, participate in steering committee meetings, report, communicate and create a clear vision and goals what to achieve.

Weekly work meetings in the team and monthly status meetings with the steering committee were held. In the most intense phase when the JCC consultant were on-site working with the pre-study team daily 15 minutes meetings were set up and included a sponsor representative from the business side to keep track on the business needs and have a close dialog.
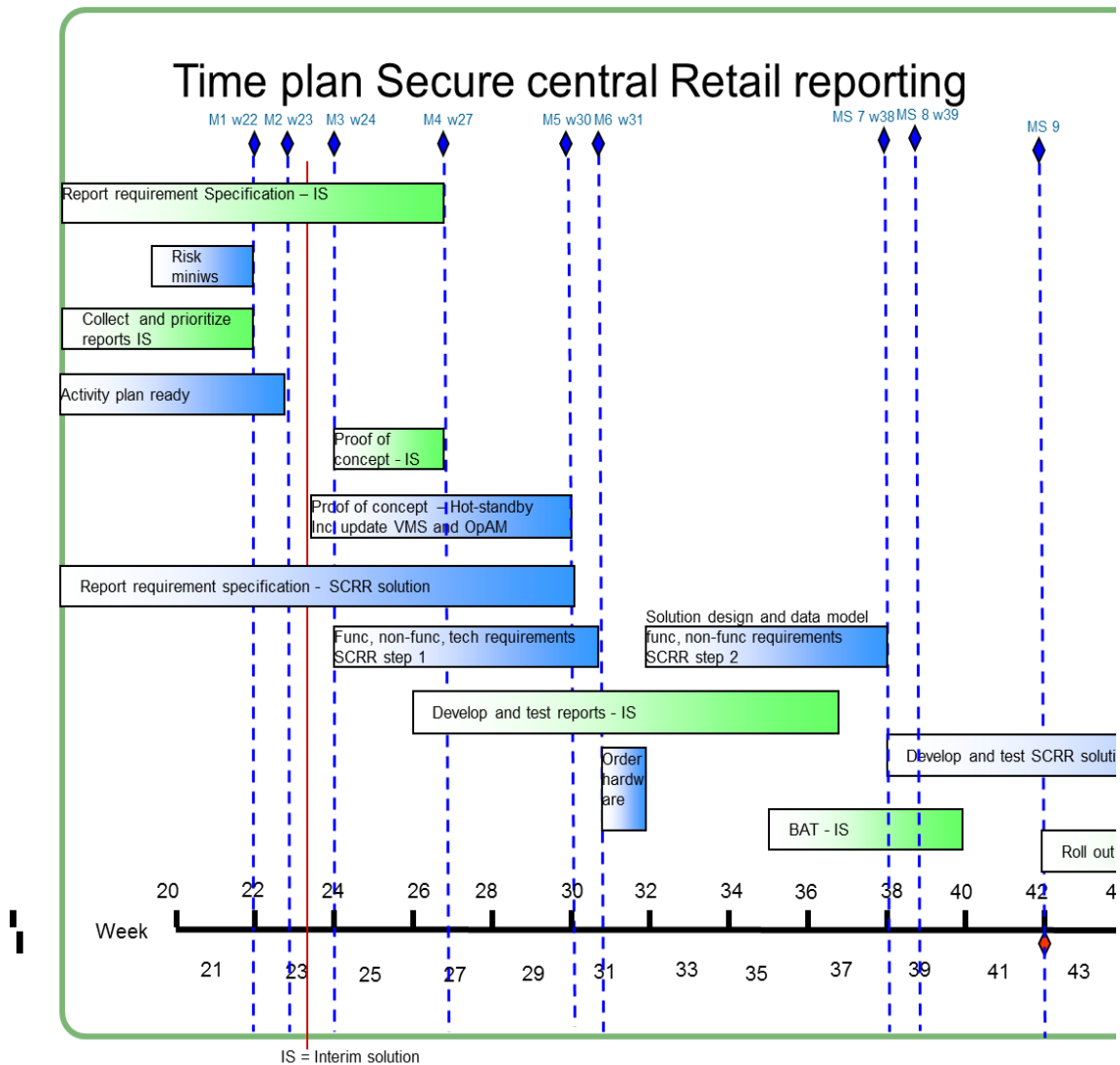
Figure 5: High level time plan SCRR pre-study.

1.3.2 Literature study

JCC LogMiner Loader was the initial proposal how to meet the business needs. Since this software is very expensive and not already in use at the company, the pre-study sponsors required that the pre-study should include a benchmark by performing a comparison to other replication alternatives. No proof of concept was required but a literature study and consultation with solution specialists to collect an objective view of the different alternatives and consequences for the company. The result of the literature study is a solution alternative document including consequence analysis. Parts of this document are included in this thesis in chapter 2 Solution Study Summary.

Since the company wished to compare techniques already in use some of the information could be gathered by contact specialist within the company and get their personal view based on their senior experience.

The other alternatives was investigated through interviews with external companies via phone and email and there official documentation on their Internet home pages.

1.4 Information gathering

To be able to gather all necessary information live meetings via the WEB was set up and JCC specialists were invited to present a proposal how to set up the environments and software licenses needed for application installations were rented.

An important part of the reason why the proof of concept were successful was that the pre-study team could invite one JCC specialist from USA to join on-site and help the team with the first steps of the installations, configurations and data replication.

Another important part of the case study was to verify with a third party that the idea was the best solution. Therefor an Oracle RDB expert from Oracle was consulted via email and phone to discuss the replication solution.

All information was reviewed by the company´s IT chief architects for each related IT solution area. The literature study documentation was a base for, and included in, a blueprint that is the required architectural input directive whenever the company starts a new project.

1.5 Source criticism

The sources in this thesis are in some cases experts within specific areas. Since the experts are humans they might have a subjective vision and opinion of current used applications. Why interviews with experts were chosen as information sources rather than further case studies is that the company relies on that they are putting the company´s best interest first and have earlier shown to the company that their opinions has given successful results in former projects.

Some of the tests that were proposed were limited due to time constraints. The pre-study had time as priority 1, quality as 2 and cost as priority 3.An example of a test that were excluded in the proof of concept was to set up a 300-to-1 test environment to prove that JCC LogMiner Loader can replicate and unload from more than 45 sources to one central source. To prove that it is highly expected that it can, JCC consulting Inc. performed those tests in their laboratory environment in USA using their own data. The results did not indicate that JCC LogMiner Loader should be disapproved by the company by this reason.

Articles and presentations produced by Oracle, Hewlett & Packard could be experienced as company subjective from a market sell point of view. But since these companies are leading companies in the market and connected to the company since many years this was seen as most untrue that they would suggest the company to implement a solution they cannot help us support in the future. Oracle proposed that the company should choose JCC LogMiner Loader instead of their own application since they had better experience of the support and maintainability from JCC LogMiner Loader.

The author recommends the article [10]Guidelines for conducting and reporting case study research in software engineering and the book [12]Case Study Research : design and Methods, as checklist material and case study reliability support. Both of them explain validation of information reliability in a practical way. The author used the checklist as follow-up tool to verify the content of the thesis. But also recommends to use it as a complement for better planning of the work.

Definitions, Acronyms and Abbreviations

Term	Description
SCRR	Secure central retail reporting – The name of the pre-study
Hot Standby solution	Database updated with the latest transactions which resides on a different location than the original database source.
Hot Standby master database	Source database, in this case retail store database in the store.
JCC LogMiner Loader	Software to replicate data from one or more databases to one or more databases.
Oracle/RDB LogMiner	Function within Oracle/RDB to retrieve data from database log files to be used by JCC LogMiner Loader.
JCC LogMiner Data pump	Function within JCC LogMiner Loader to be able preload data into report database. Only used during implementation or when complete tables should be reloaded.
AIJ file	Oracle RDB After Image Journal file. File containing applied transaction to the database.
PoC	Proof of Concept
SLA	Service Level Agreement
PPS	Practical Project Steering, a project method

1.6 Background

Today the company are missing operational data to do reporting, benchmarking and performance management on a global level within the retail organization. Reporting information is currently only possible on local store level and partly (with limited possibilities) on a country level. The work to get the information into today's reporting tool set is very complex and time consuming. As an example 'Availability Reports ' in the Service Office organization teams = per person 1-2 hours a day, per country and these 'applications' are not standardized and therefore are not supported by IT.

There is at the same time a need of a disaster tolerance solution for retail store databases systems. The retail store system is a business critical system for the company. Today daily system backups are saved to handle local major incidents for the system. A major system failure in a store can take time to restore, up to six hours. With a new centralized disaster tolerance solution a central backup server could standby to take over within an hour.

These both needs have parts in common and the idea came up to combine them into one solution.

The proof of concept, that was part of the pre-study, was initiated to investigate how to implement a central reporting solution for all retail stores combined with a disaster tolerance solution for the retail store systems.

The latest BI tool strategy by Enterprise Architecture is requiring that today's tool set is to be phased out and replaced (for the many) by the Cognos BI tool, thus the solution needs to emphasize the use of Cognos.

1.7 Challenge Description

The company currently has 297 retail stores in 26 countries and is still expanding. This implies a large amount of data, various time zones and will raise synchronizing research questions.

To be able to restore from a disaster tolerance solution the company needs to have a database replication solution to replicate retail store system data separate from the store locations. In the event of a major incident at the store where the local business data in retail stores are not available (currently as local backup tapes), for example due to major damages in the store, the data can be restored from a central Hot Standby solution. This requires a fast WAN network with high availability.

1.8 Purpose and goal

The purpose of this thesis is to prove whether the software applications JCC LogMiner Loader and Oracle Hot-Standby can be used to fulfill the end user and infrastructure needs and requirements.

The goal is to conclude and recommend a solution design that fulfills the needs described in the pre-study directive both from a technical and financial perspective so that a project can be initiated to implement this solution.

1.9 Problem formulation

The thesis shall answer the question if it is possible to use the two software applications JCC LogMiner Loader and Oracle Hot-Standby to secure and meet the company´s needs and requirements.
The pre-study Secure Central Retail Reporting shall deliver a document *Solution Study Summary* that will be the Basis for Decision by performing a Proof of Concept and include a budget estimation covering 5 years from project initiation including hardware, software, licenses, resources, IT team education, design, development, implementation, roll-out and support. The pre-study findings will be input to a Project Directive draft and a high-level project time plan.

The proof of concept shall be based on the assumptions from the in-delivery document *SCRR Operational data from MHS P1.2*.

The document *Solution Study Summary* shall include a network impact investigation with Hot Standby solution and propose solution alternatives based on time, result and cost.

1.10 Proposed solution – in delivery to pre-study

The draft idea that was the base for the proof of concept shows [see fig 6] how JCC LogMiner Loader replicates data from Hot Standby mirrors in one central environment.

This solution was discarded already in the startup of this pre-study and thesis since Oracle and JCC Consulting, Inc. confirmed it not possible at this time and there exists no active plans to change in the Hot Standby source code during year 2012/2013.

The reason why it is not possible to use for the solution the company needs is that JCC LogMiner Loader needs to not only read from, but also write to the source to be able to update the central reporting database correctly with

timestamps on row level. The Hot Standby mirror is no longer a mirror of the local retail store database and can therefore not be used as a recovery solution.

System overview
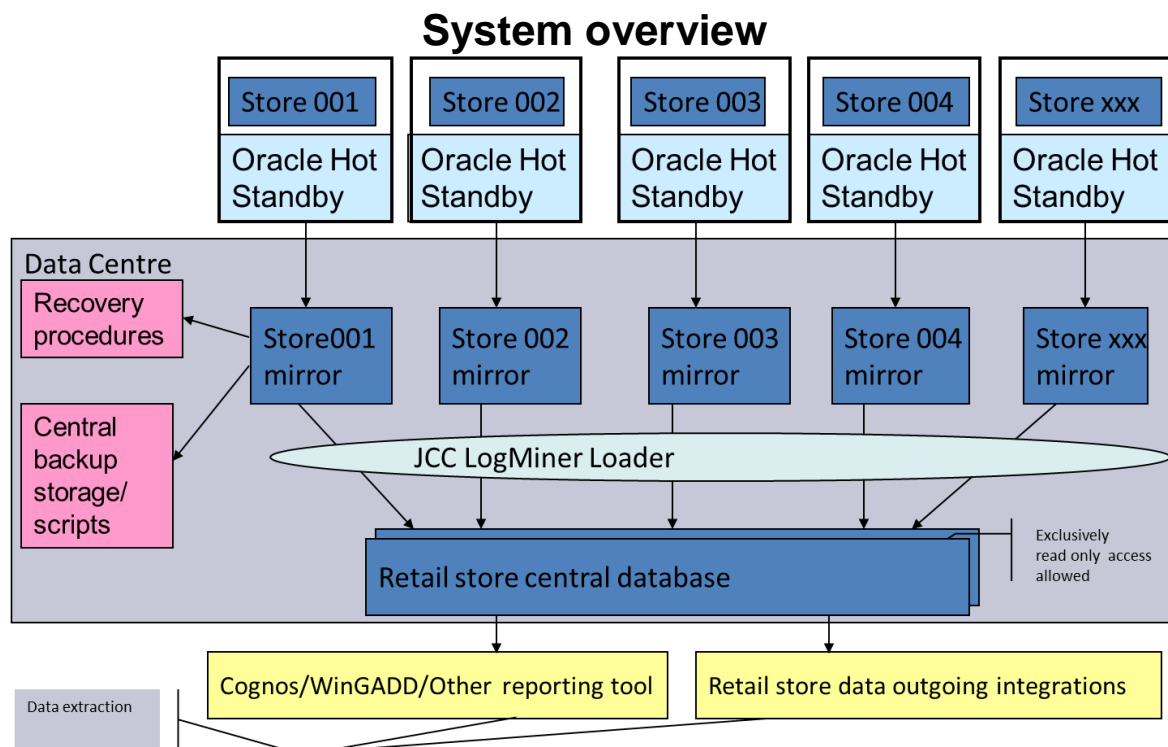
Figure 6: JCC LogMiner Loader extracts data from Hot Standby mirrors.

1.11 Scope and Delimitations

The scope of this proof of concept is to prove if the solution complies with the needs of the centralized reporting, to compare pros and cons with other available solutions and if possible to combine with needs of a Hot Standby database solution for the retail stores.

The needs for central retail reporting are:
Retail store business data should be available from all stores for reporting on a global level.

Centralized retail store data should be updated from the stores at least four times a day and if possible once an hour or less.

The needs for the Hot Standby solution are:
Be able to restore retail store application and database within one day on a different location than the original store location, in the event of major disaster at a local store.

1.12 Pre-requisites

The solutions are based on the following technical and support solution requirements:

- ✓ In the near future the company will have up to 300 retail stores to support and retrieve business data from.

- ✓ The centralised solutions are to be located in Älmhult data centre.

- ✓ OpenVMS platform which easily can communicate with the same platform for the retail store systems and for high availability.

- ✓ Report tools such as GADD, QlikView and Cognos must be supported.

- ✓ Oracle/RDB database for centralised database which is the same as in the retail store databases in the stores.

- ✓ Oracle/RDB Hot standby solution for database replication. To be used for disaster tolerance solution.

- ✓ Oracle/RDB LogMiner functionality within Oracle/RDB with JCC LogMiner Loader. To replicate data to be used for centralised reporting.

- ✓ The solution uses the company´s SAN for centralised data storage for the centralised
  hot standby and reporting solutions.

- ✓ The solution uses current company LAN and new WAN network to replicate data between stores and centralised systems.

- ✓ The solution must comply with the company´s policies and standards.

- ✓ Be managed and supported by the company´s IT support organization.

2 Solution Study Summary

2.1 Introduction

The PoC has investigated a solution which consists of a central reporting solution and disaster tolerance based on data replication. To replicate the report data from the retail store systems into one central reporting database, and to replicate complete retail store databases for disaster tolerance.

The solution is divided into two parts:

1. The central retail report solution with the purpose to replicate the retail store data needed for the reports using Oracle LogMiner together with JCC LogMiner Loader.
- Oracle/RDB LogMiner is a function within Oracle/RDB to be able to replicate data, and Oracle/RDB is the database for the retail store application. JCC LogMiner Loader is a tool to replicate data using

Oracle/RDB LogMiner to collect the data from the database using the transaction log files. JCC is a HP Alliance One partner and is recommended by Oracle. Oracle RDB/ JCC LogMiner Loader can replicate to several targets: XML, JDBC, Oracle 11, RDB, etc.

2. The disaster tolerance solution which is based on Oracle/RDB Hot Standby function included in the Oracle/RDB license.

   The Oracle/RDB Hot Standby function replicates a complete database to another location called the standby database. The goal of the standby replication is to have a "copy" of the database which is in synchronization with the source database. The standby database is used to restore store operation in a situation where the local retail store server and/or database has suffered a severe failure.

The two solutions can benefit from each other sharing the same hardware and software platform [see fig 4 and 5], support, and licenses to reduce investment cost compared with having complete separate hardware, software, support and license solutions.

The two solutions can also be implemented separately with different time frames. The central retail reporting solution can for example be implemented first and the disaster tolerance solution later, using the same technical platform.

2.2 Benefits

Chapters below list savings that the company can gain if they automatize the report executions and exchange the local back-up solution to a central disaster recovery solution, both from a short and long perspective.

2.2.1 Immediate benefits

There are benefits that will generate payback to the company and end users immediately when solution is implemented.

- Central Reporting Tool follows the BI strategy of the company which means full application support.

- Possibility to run reports any time during the day without risking impact on retail store local systems.

- Centralized retail store data storage where users can retrieve data for reports on global level. This benefit requires a roll out on at least country level.

- Less time consuming way to support application reports and data going from retail store since it can be retrieved from the centralized data storage, instead of using the local stores retail store databases.

- Reduce loads generated by running reports in the stores retail store systems. Today data and report information have to be collected locally in each store.

- New possibilities to use report data to cover more than one store in business reports or to send data to other systems.

2.2.2 Disaster tolerance solution for retail store

Implementing a central recovery solution benefits immediately each and every retail store in the same order they are rolled out with the new solution. There is no dependency between the retail stores. Today backups are taken to tape containing the retail store application and database in each store. These tapes are managed locally by the store. The goal with the solution to replace the tape backups with a centralized Hot Standby solution, combined with the current backup solution. The Hot Standby solution will replace the local tape stations.

In practice it will mean that in case of severe problems with the local retail store server, central IT production support will restore retail store service at the standby server instead of waiting for HP to send a technician to the store. When the local server is repaired the retail store service will be redirected to the local server.

The solution consists of having one or more centralized Hot Standby servers depending on the network capacity between the stores and the centralized Hot Standby server location. The Hot Standby servers contain almost real time updated database copy of the store's retail store database.

- Faster retail store system recovery in the event of a major or fatal incident at the local store causing the local computer environment with storage, data, and information to be lost.

- Higher level of disaster tolerance in the retail store application and system.

- Reduce hardware support costs for backup device for each retail store system.

- Reduce time for downtime for backups and maintenance.

2.2.3 Future benefits

When the solution is implemented there are long term and future benefits that can be taken into consideration if the company continuous working with optimizing the data integrations.

- Reduced retail store batch time by moving outgoing integration and report generation to central retail reporting solution

- One step closer to 24/7 selling in the stores

- Shorter or no downtime for SGF Mobile

- Replicate data from production to test environment for improved test quality

- Less risk for database locking

- Possible integration from central node instead of ~300 nodes.

- Possibility to archive and store retail store data for longer time periods compared with today using the central report server.

- Possibility to take "snapshots" of the central report server make reports for a specific time like "FY shifts", Half year reports, etc.

- Possibility to log activities in the databases (for example for security, capacity reports etc.)

2.2.4 Other benefits

- When the project is changing the physical retail store database layout there are possibilities to have a retail store database review. To review and, if found any issues, optimize the database when applying the Hot Standby and Central Retail reporting solution. This will need an experienced Oracle/RDB DBA, which is also a need for the future support and implementations.

2.3 Central Retail Reporting solution for retail store

The central retail reporting solution is based upon database replication using Oracle LogMiner and on the retail store databases in the stores, together with the JCC LogMiner Loader to load the data into one central report database at the central report server.

2.3.1 On each retail store server

In the stores it will once an hour unload new or modified data in selected retail store database tables to a transaction data file. The transaction data file contains only updated transaction data needed for reports at the central server.

JCC LogMiner Loader will then send the transaction data file over the network to the central reporting server.

The unload interval is based on the time it takes to unload the data, time to send it over the network, and time to load the data in the central report server. The unload interval is also dependent on performance and capacity in the retail store server, network load and capacity, and the performance in the central server to load the data in the central reporting database.

2.3.2 On the central reporting server

On the central reporting server JCC LogMiner Loader will monitor for arrived files from stores and check if the files are valid and ok. If the file verifies good the file will be loaded by using JCC LogMiner Loader.

The JCC LogMiner Loader on the central server will then load files sent from the retail store stores containing transaction data into selected tables used for reporting.

The central database will be similar to the retail store database, but far from identical. The most obvious difference is that store number is added to each record. Less obvious is that the central database will be optimized for running reports with Cognos.

Users can run predefined reports in WinGADD, Cognos and QlikView and retrieve report information from the central report server.
To implement this solution there are number of preparing activities and actions that were detected during a work breakdown structure workshop.

- Set up a central server with one central report database in Älmhult data center. A one or two node cluster running OpenVMS and Oracle RDB connected to the SAN and WAN in Älmhult is recommended by the pre-study team.
- Install JCC LogMiner Loader on central server and on each retail store application server. This is needed to be able to send transaction data from the stores to the central report server and to load the data on the central report server.
- Configure the JCC LogMiner Loader on the retail store server which database tables should be replicated to the central reporting database.
- Configure the JCC LogMiner Loader on the central server to load data using

data files sent from the stores containing database transactions, also called using LogMiner Loader in COPY mode.

- Modify Enable Oracle LogMiner functionality on the each retail store database in the store.
  This will change the information in the database log transactions files to include needed information to replicate data to the central server.
- Modify the database transaction logging behavior from today one transaction journal log to several transaction journal logs (AIJ files). This is to be able to online extract transaction journal data, needed for the report data replication.
- Modify tables in the retail store database in the stores to have unique primary keys for the database tables being replicated.
- Design and create one central database in the central reporting server, based on Oracle RDB to receive report data from the stores.
- Design and configure the central database storage areas, database tables to contain store number, and create indexes to optimize reports performance.
- Change the retail store database backup behavior in the stores to comply with the new report data replication solution. The current solution is to close down the database once a day, take a backup of the database, and create a new transaction journal file. The new way must be an online backup without closing down the database. Then unload the transaction journal file to a transaction journal backup file, which is processed by the LogMiner solution.
  The result will be the same in the aspects of a database security and management, but in a different way.
- Creating new automatic routines to save, extract, and send transaction journal data over the network to central reporting server for updating central reporting database. Theses routines must be designed tested and coordinated together with the retail store application support as an integrated part of retail store support management routines.
- Creating new automatic routines to receive and update central reporting database at the central reporting server.
- Creating new monitoring, alarm and support routines to supervise and support the reporting solution both in the local retail store systems at the stores, as in the central reporting server. Theses routines must be designed tested and coordinated together with the retail store application support as an integrated part of retail store support management routines and current retail store monitoring solution.
- Educate and train application and operation support organization in the replication solution and database design by attending Oracle/RDB seminars held by JCC or buy training on-site from JCC in Oracle/RDB.

- Dedicated Oracle/RDB database analyst to support and manage the central database solution and the retail store databases.

Today there is no dedicated database specialist on Oracle/RDB. The organization relies completely on external consultant resources. With this solution the pre-study team recommends a permanent database analyst on site. DBA support is needed for activities such as:
  - Support and manage the database replication solution
  - Supporting the retail store application support in database design issues, needed for the central reporting database as well as the integration with the retail store application.
  - Proactive monitoring and supervise the solution and databases.
  - Plan, upgrade and develop the replication solution for future releases.
  - When needed; train and educate more Oracle/RDB DBA resources within the areas of Oracle RDB database management and JCC/Oracle LogMiner solution.

2.4 Hot Standby solution for retail store

The Hot Standby solution is mainly a disaster tolerance solution for the retail stores. In the event of a major disaster at the store where the local system and data has been destroyed, the solution makes it possible to recreate the each retail store application data from a copy of the store's database at a different location.

The solution is based on Oracle/RDB Hot Standby solution, which makes it possible to replicate an entire database at a different location than the source database.

The solution works with synchronizing the retail store database against a standby database using the transaction log files. The solution copies every insert, delete or modification transaction in the retail store database to the standby database, and applies the transactions to the Hot Standby database in secure and controlled way. The transactions are sent in real time and are updated as fast as possible in the Hot Standby database (not real-time due to amount of data). The Hot Standby database is always in update mode waiting for or updating transactions sent by the retail store system. The Hot Standby database cannot be modified during normal Hot Standby operation by other applications since it is no longer a pure copy of the source and thereby cannot be used as a mirror back-up.

To implement this solution the OpenVMS and Oracle system specialists have defined a number of actions and activities:

- Configure and modify the retail store databases for Oracle/RDB Hot Standby, and connect to a central Hot Standby server.
- Setup and install one or more centralized Hot Standby servers based on OpenVMS and Oracle RDB. One server should be placed in Älmhult connected to SAN and WAN network.
- Prepare the central Hot Standby server with an initial copy of the retail store physical database from the retail store stores.
- Enable and start the Hot Standby replication on master retail store and standby centralized standby server in COLD mode.
- Creating new automatic routines to start, stop, and manage the standby solution. . Theses routines must be designed, developed, tested and coordinated together with the retail store application support as an integrated part of retail store support management routines.
- Creating new routines to failover retail store database in the event of major disaster. Theses routines must be designed tested and coordinated together with the retail store application support as a integrated part of retail store support management routines.
- Creating new monitoring, alarm and support routines to supervise and support the Hot Standby solution in the local retail store systems at the stores, as in the central Hot Standby server. Theses routines must be designed tested and coordinated together with the retail store application support as a integrated part of retail store support management routines and current retail store monitoring solution.
- Educate and train application and operation support organization in the Hot Standby solution and changes in the retail store database layout.
- Dedicated Oracle/RDB DBA within the support organization to support and manage the central database solution and the retail store databases.

During the proof of concept the pre-study team tested the Hot Standby solution on an education system in Australia with a Hot Standby server in Helsingborg with good results. But this was an education server with no live users and store activities. It is hard to simulate a live store, and it is recommended to run a pilot to further test and evaluate if the network capacity and reliability is enough over network distances.

Tests included setup, configuration and performance of Hot Standby solution in a test environment. A pilot could verify how the solutions affect a real production environment in performance, and disaster tolerance procedures. More about the test environment is described in chapter 2.9.

2.5 Possibilities with shared hardware environment

There are many advantages to combine the two solutions, disaster recovery with Hot Standby and information consolidation with JCC LogMiner Loader:

+ Share the same centralized environment which will get advantages like clustering for better availability and capacity in the centralized report server and standby server.
+ Cost savings due to shared hardware. Lower costs for IT infrastructure e.g. hardware central server (Server and Storage), management routines and procedures.
+ Share license costs for Operating system and Database management.

2.6 Risks with shared hardware environment

Risks that need to be discussed and investigated, eliminated, or avoided by proactive actions and decisions:

− Longer implementation times and delays due to extra work if setting up both solutions in parallel.
− Higher hardware cost due to need of more capacity in the central environment to run both parts (Central reporting & Hot Standby) in the solution, comparing to only run one part of the solution (Central Reporting). But if there is an intention to run both solutions there also will be savings and benefits to combine the solutions in a common hardware environment.
− Local solutions in retail store which use temporary database table might cause problems.
− All changes for both central retail reporting and Hot Standby to the retail store database must be applied, compared to making the changes in steps, as the reporting need increases when implementing only the central retail reporting. Implementation of necessary changes in retail store will take longer time and have larger impact on other changes in retail store releases.

2.7 Working Methods and Routines Review

During the pre-study it was detected that the solution will affect the way the IT organization work and support the retail store application. The replication solutions will demand as stated above more database management and support than before.
This solution will affect the retail store application support in following areas:

• The central report solution must be synchronized with any physical database changes made to the retail store database. Otherwise the replication will fail. Retail store application support must synchronize

all changes made to the local retail store database with changes to the central retail reporting database. The effort will be dependent on how much of the changes is part of the local retail store database that is made available for reporting. This is similar to the change process used today.

- New ways of manage the retail store database application.
  The databases have now new dependencies to the Hot Standby solution and the replication solution if these are implemented. This needs as stated before an Oracle/RDB DBA competence in the support organization, for both DBA management as in application management and design.

2.8 The centralized retail report and Hot Standby environment

The pre-study team has designed an environment to support both the Central Retail Reporting solution and the Hot Standby server solution.

The environment is planned to be set up in a Swedish data center. The server solution is based on an OpenVMS cluster to support requirements from Hot Standby solution and at the same time support high availability, capacity and to be able to enable for future demands and growth.

Initial the cluster consist of two Itanium IA64 blade servers connected to the SAN in Sweden. Each server can take over the each other if one fails. The pre-study team see the clustered solution will benefit availability, flexibility and for future growth.

Hardware overview

Network LAN/WAN

HP Integrity	Management Lan	HP Integrity
BL870ci2 c7k		BL870ci2 c7k
Server Blade		Server Blade
192 GB memory		192 GB memory
2 CPU (8 cores)		2 CPU (8 cores)
OpenVMS 8.4		OpenVMS 8.4
(Älmhult)		(Älmhult)
Internal 146GB Raid 1		Internal 146GB Raid 1

Fiber channel

Raid San Storage in DC7 and DC8
(Älmhult)
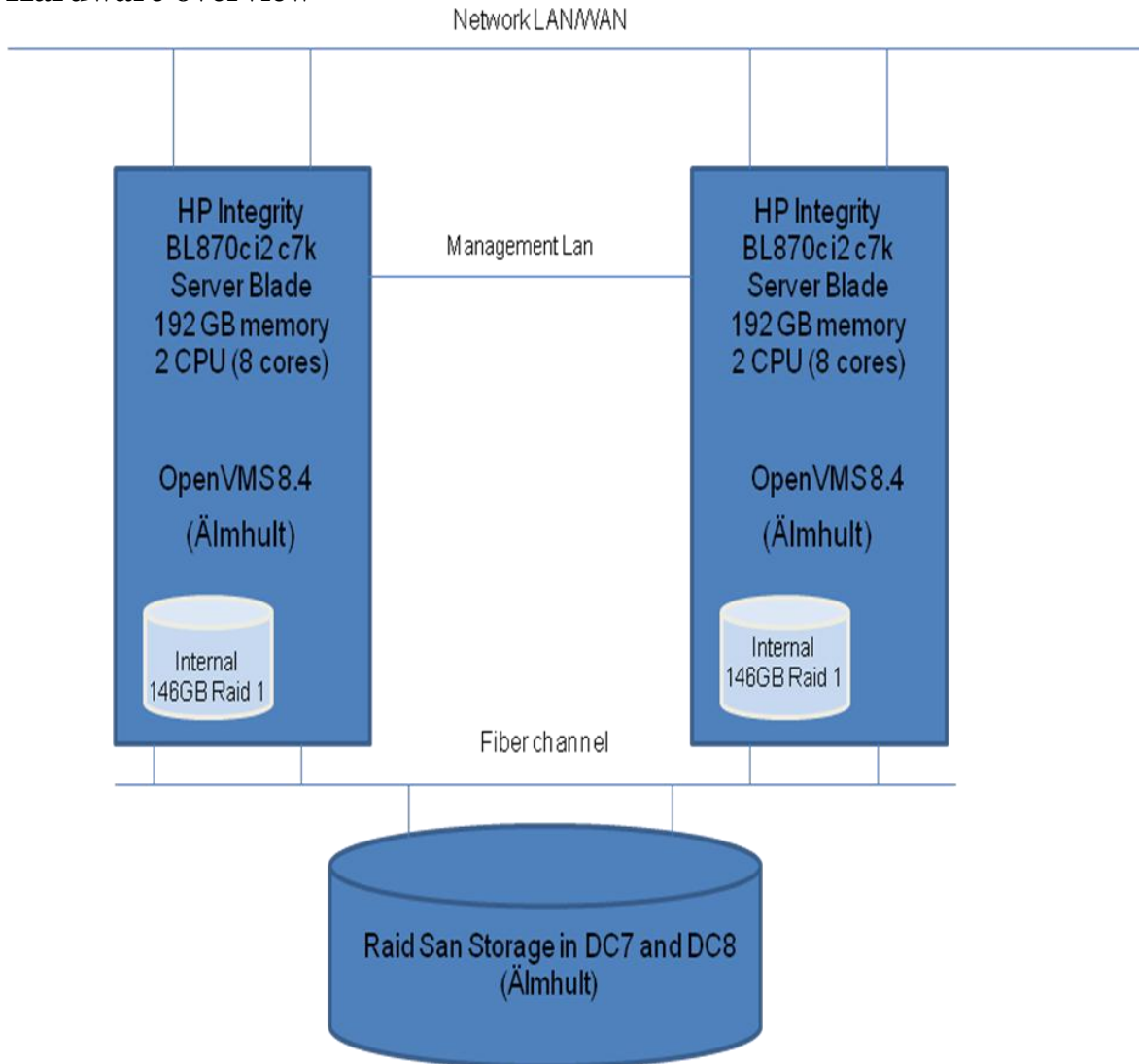
Figure 7: The central report/standby server cluster

2.8.1 Alternative production environment for only central retail reporting

If the decision is to only go for a central retail reporting the hardware environment can be modified to only have one server, instead of two servers in a clustered environment. But this is not recommended by the infrastructure specialists within the company from a recovery point-of-view. The amount of disk storage will also be smaller. The exact amount of disk storage has to be calculated.

It is possible to implement the two parts of the solutions separately in time if this is a need. It is possible to start with a one node cluster at the beginning and add on more servers when the need is to implement the second part.

2.9 The Proof of Concept test environment

To be able to perform a proof of concept the test environment had to fulfill the end user needs and infrastructure requirements and the pre-study findings:

Training
Training in the replication tools to be able to install, configure and run the tools as supported by the vendor.

Functional test
Test the functionality and test the technical design.

Initial load tests
Basic load tests to see if major capacity problems are going to be experienced in the solution design.

Resilient tests
Basic resilient test to verify the solution can handle and recover from loss net network, server fails, application restarts etc. The used PoC test environment for this report is as follows:

- Three retail store education servers in Australia, United States, and Spain. All education systems have a copy of the retail store database from a live store and connected to the Local LAN at each service office.

- One test retail store test server in Helsingborg test environment with a copy of M00012 retail store database.

- A central report/Hot Standby server in Helsingborg. The server is a HP rx4640 (4 cores) 1.5 GHz blade server with 16GB memory and 16 shadowed 36 GB disks.

- The standby server has two clustered virtual servers. Operating system is OpenVMS 8.4 with Oracle/RDB 7.2-420.

The servers are connected to local test LAN in Helsingborg.

2.9.1 Differences between PoC test environment and the planned designed solution

The major difference between the planned designed production environment and the test environment for the proof of concept is the much lower capacity in the test environment. It was not possible to have the same hardware solution

for the PoC. The production environment is going to be connected to SAN, while the PoC environment is connected to local SCSI disks.

Regarding the retail store simulation it was not possible to simulate an open store in the education and test systems due to project time constraints. There is no activity in the education systems to run batches to generate some kind of load. JCC LogMiner Loader data pump was used to generate load in the education systems databases during the tests. An integration pilot will verify if the capacity and performance calculations done in the test environment comparable to a production environment.

2.10 Findings

During the start-up of the pre-study it was found that the Hot Standby mirrors are read-only and thus the JCC LogMiner Loader cannot make use directly of the data in those database mirrors [see fig 6].
Tests and investigations during the pre-study work generated findings described in below chapters.

2.10.1 Future solution
JCC LogMiner Loader and Hot Standby solution both replicate data from retail store systems.
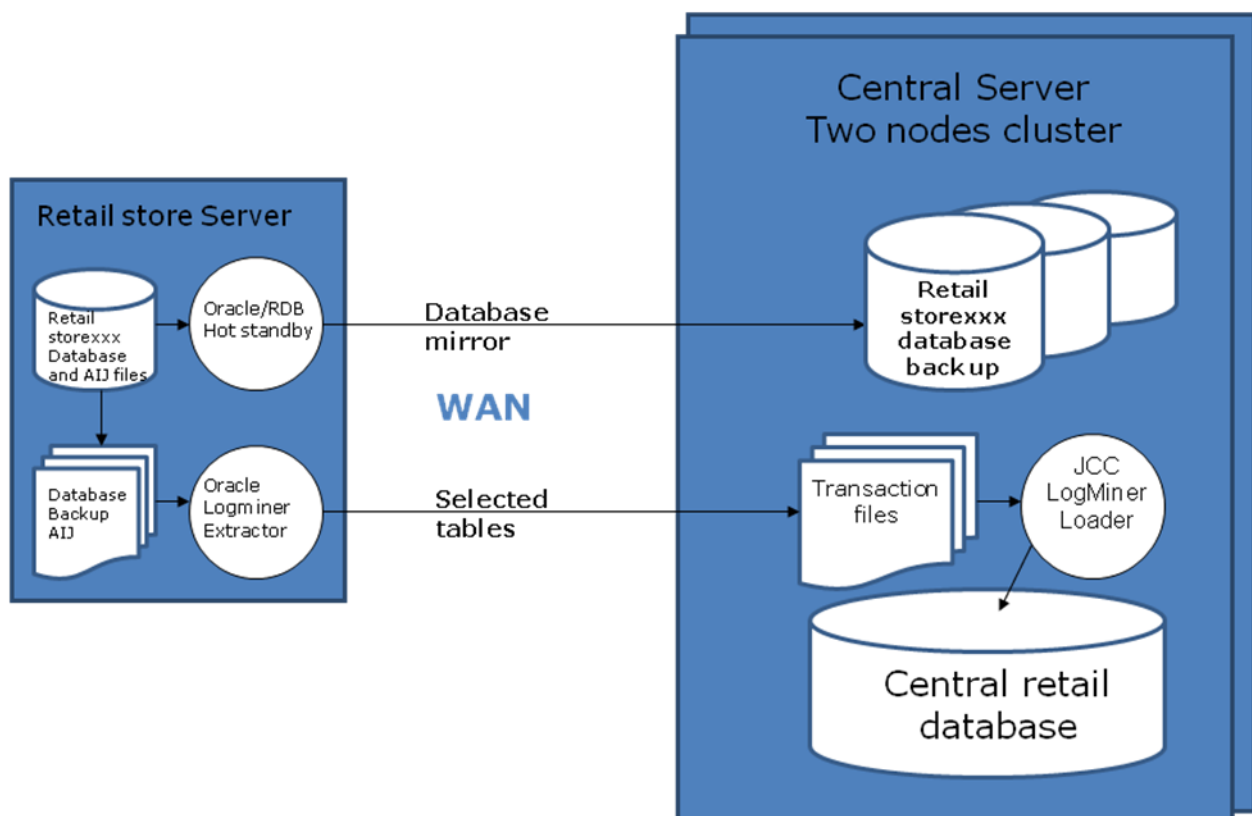

Figure 8: The combined central retail reporting and disaster tolerance solution.

2.10.2 Real time reports not available

The solution cannot deliver real time data in the central report server.
Due to the current Oracle RDB LogMiner functionality (read-only) it is not possible to use the Hot Standby databases as source databases for extracting data to the central report server. Instead it has to be extracted the data from the retail store database in the store, and copy transactions over in transaction files to be loaded by JCC LogMiner Loader in the central report server. The Hot Standby solution is not integrated with the central retail report solution other than sharing the same hardware and operating environment.

Estimations done by the pre-study team shows it is possible to deliver data within one hour interval during the stores opening hours. During nights when the night batches run, the frequency of the data transfer might be lower.

2.10.3 Changes to be made to the retail store database

To be able to replicate data from the retail store stores and to enable Hot Standby some changes is needed on the current retail store database:

- Add unique keys on identified tables in the database to be able to replicate.
- Enable LogMiner functionality to the retail store databases.
- Modify the transaction management in the database to have rolling AIJ files instead of today one extended AIJ file.
- Modify the backup, restore, and recovery routines for the retail store databases to handle the replication process.
- Change start and stop routines for retail store servers to include Hot Standby and table replication.
- Enable Hot Standby on the retail store databases.

2.10.4 Changes in retail store application development and rollout routines

For both the replication used for the central reporting and the Hot Standby solution all changes which relates to the retail store database physical design like table changes, column changes, index changes must be coordinated and updated with the replication and standby solution. This means that the change process for retail store application must always include aspects how it will affect the central report and Hot Standby solution. The central retail reporting solution will almost be a part of the retail store application because the close dependency.

2.10.5 Need of combined testing with retail store application

All new releases of retail store which include database changes must be tested together and against the central report and standby solution. There will be a need of test environments e.g. pre-production environment for Hot Standby and central reporting.

2.10.6 Need for Oracle RDB competence in VMS retail support

When implementing, supporting, and for future development competence is needed to support retail store application support as well as VMS retail support in following areas:

- Oracle RDB database management
- Oracle RDB Hot Standby solution
- Oracle RDB/JCC LogMiner loader and data pump solutions.

Currently the need has been satisfied with contracting consultants. But if these solutions are implemented more support and competence is needed in Oracle RDB.

2.10.7 Need for Oracle RDB competence in retail store application support

To be able to support the new functionality and future development with the dependencies to the retail store application such as:

- Retail store application design
- Retail store database design and support
- Application report design, support and functionality
- Coordination with retail store application functionality and future needs.

As for VMS retail support the need has been satisfied using consultants. The need will increase when implementing these solutions.

2.10.8 New operation management routines

New routines needed to supervise, manage, and control the central retail reporting solution and Hot Standby solution. Routines need to be implemented to:

- Extract transactions from AIJ files for central reporting.
- Send files with transactions to central report server.
- Load files with transactions into central reporting server.
- Start, Restart and stop Hot Standby solution.
- Failover database from standby database to retail store database in the event of disaster.
- Monitor and supervise Hot Standby/Replication solution with integration to BMC Patrol.

2.10.9 More than 60% of retail store database transaction activities are made during night batch

Observations were made that in the stores over 60% of all transactions in the retail store database are done during night batches in retail store. Nights batches in the stores are run after the store is closed and takes about 30 minutes to one hour to complete. This means the heaviest load on the central report server will be when updating transactions done during night batches in the stores. The heaviest load will be when Europe (CET) runs night batch.

2.10.10 The optimal Hot Standby mode is cold mode for retail store databases

The Oracle Hot Standby solution can work in three different modes:

- Commit mode.
  This is the most tightly consistent and synchronous level of replication. The commit mode requires that the standby database be identical to the master database.
  To guarantee that the two databases are always consistent, the Hot Standby product employs this mode using a two-phase commit protocol. Performance can be affected because this mode can consume extensive system. The databases must always be identical in time. This mode demands high network capacity and very low network latencies otherwise it will slow down the application.
- Hot mode.
  The hot mode of synchronization brings the standby database extremely close to being transactional identical to the master database. After-image journal records in transit are received and committed. Some restart processing may be required to synchronize the databases.
- Warm mode.
  The warm mode of synchronization brings the standby database transactional close to the master database, but the databases are not immediately identical. In failover situations, it is possible for transactions to be committed on the master database, but the same transaction might be rolled back on the standby database.
  If this occurs, the Hot Standby software automatically resynchronizes the databases when you restart replication operations.
- Cold mode
  This is the loosely consistent and asynchronous mode of replication. Asynchronous processing updates the master database and then asynchronously propagates the changes to the standby database. During normal operations, the standby database lags behind the master database to some degree. With this mode, it is possible for the standby database

to become identical to the master database only if updates to the master database stop or are stalled (such as through a database quiet point).

For the moment JCC propose cold mode operation for retail store databases due to network capacity for stores with long network distances. The pre-study team has observed major degrade of application performance when running in higher modes for long network distances stores like for stores in Australia.

To have higher modes with higher performance the WAN has to have more capacity, or the standby database has to be installed in a server closer to the local retail store server. In case of performance degradation due to Hot Standby low network capacity, it is possible to have the Hot Standby server installed in a server at the service office instead of central location in Sweden.

2.10.11 Large stores generates over 1 million database transactions per day

It has been observed during the pre-study that in larges stores like in Germany and some of the Asian stores over 1 million database transactions are done during a day. For example one Asian store generated during 24 hours 2 million database transactions.

2.10.12 Use LogMiner solution in Copy mode

During the PoC it was found the most optimal way is to install and run the Oracle LogMiner and JCC LogMiner solution extracting transaction data from the database transactions files in the stores, and copy the transaction data in files over the network to the central server reporting server. In the central server the JCC LogMiner tool will load it in to tables in the central reporting server continuously.

2.10.13 Central report environment will use parallel JCC LogMiner loading processes

During the PoC the pre-study team found that to load report transaction data in parallel is more efficient compared to one sequential load in the central reporting server. Measurement was made on 4 parallel processes in the PoC test environment and reached in total around 11 000 transaction rows/second compared to half when loading one single load. Important to know the loads are different in amounts of data from each store. But there are benefits of using parallel loading data processes using JCC LogMiner Loader in the central environment. Today's estimation shows at least 10 parallel processes to load in data in the central server. For more information see figure 9.

The tests were performed at specified dates at:
Source node time: 9.00 pm
AIJ Size (Blocks): 137530
LogMiner Unload Time: 4.99
Unload Size (Blocks): 128386
Copy Time (Ave): 4.00
Total Time (s): 8.99
HS mode: Cold
Data pump: 00.14.00
Update at master with hot standby transactions/second: 413. 269048
Update time/trans at master with Hot Standby (ms): 2.41973

Date	Unloaded rec	JCC load time	Notes
20110722	347146	371	1 simultaneous checkpoint 1
20110722	347121	123	1 simultaneous checkpoint 5
20110722	347071	95	1 simultaneous checkpoint 10
20110725	346971	79	1 simultaneous checkpoint 20
20110725	346971	68	1 simultaneous checkpoint 50
20110725	346971	63	1 simultaneous checkpoint 100
20110725	344971	61	1 simultaneous checkpoint 500
20110725	339971	61	1 simultaneous checkpoint 1000
20110725	347146	747,45	4 simultaneous checkpoint 1
20110725	347121	158	4 simultaneous checkpoint 5
20110725	347071	111,4	4 simultaneous checkpoint 10
20110725	346971	85,8	4 simultaneous checkpoint 20
20110725	346971	83	4 simultaneous checkpoint 50
20110725	346971	72,5	4 simultaneous checkpoint 100
20110725	344971	69	4 simultaneous checkpoint 500
20110725	339971	69	4 simultaneous checkpoint 1000

Figure 9: Unload test results.

2.10.14 Central report server environment will be updated with daily and nightly transactions

After measured all database transactions in some large stores the proof of concept concludes following:

An average of 30 000 transactions for the whole database/hour during opening hours in every store, will generate from 200 stores[1] in daily operation 6 000 000 transactions per hour in the central retail reporting database. The team experienced a transaction speed at least 5000 transactions/second. If it was updated with one sequential process it will take 20 minutes for all tables in the databases. The night batches during the same time will to these observations, generate in average 2 000 000 transactions during night batch and store. This will generate in maximum 200 stores/hour a load of 400 million transactions. If the central database is updated in one sequential process it will take 22 hours.

This conclusion is if only one loading process is implemented in the central server. In the solution design recommended by the Pre-study team it will be at least 10 loading processes handling 30 stores each. It is also assumed, based on business requirements, that not all tables will be replicated. Calculations with 10 processes loading at 5000 transactions/second the daily hourly updates will take approximate 2 minutes and the nightly batch transactions will take 2.5 hours.

Remark:
These figures are based only on the tests running during proof of concept. Figures will change due to network speeds, changes in central server platform, number of loading processes and number of tables to replicate. These figures are measured against PoC test environment and the test systems. And to these numbers are excluded the time it takes to unload and copy the data from the retail store servers. More exact calculations can be done during the pilots where it could be measured and verified on live store environments.

2.10.14.1 JCC LogMiner solution may enable future data functionality

Future functionality possibilities were discovered during the PoC in the JCC LogMiner solution, not only for reporting, but also for other purposes such as security auditing (replicate data for security auditing), logging historical activities, data archive. These functionalities are not required by the end users today but could be considered valuable for IT department when it comes to

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[1] The amount of stores is calculated from the number of stores in Europe today which is 186 and a growth of 10% the coming two years. Europe is the largest retail store region.

security, support and complexity control and.

2.10.15 Roll out of new WAN

During the solution implementation there will be activities from a project to upgrade the current WAN connection in the stores. The new WAN will benefit this project in the way of better network capacity for the solution.
The implementation project has also to synchronize and inform the WAN rollout project about the future implementation projects activities, and rollout plan.

When selecting pilots, it benefits to select stores with the new WAN implemented, and during future implementation rollouts select stores with new WAN installed.

The proof of concept have not tested the new WAN.

2.10.16 Possibility to optimize retail store database

During the PoC a number of performance enhancements were found, which is recommended to be applied to the retail store database with the new SCRR solution. It is recommended that retail store together with a DBA optimize the retail store database during the implementation. These changes will benefit standby and report solution as well as the retail store application. Enhancements on indexes, primary keys and storage areas in the retail store database are valuable examples.

2.10.17 Important with stable network connections

It is important for both Hot Standby solution and report solution to have a stable network between the store and central report server and Hot Standby server for optimal functionality. If network connections are unstable this will cause delays in replication and disturbance to Hot Standby server functionality. It can cause replication of report data to slow down, and Hot Standby to stop and to be restarted. The solution will make sure that no database transactions are missing in the central retail reporting database, but only delayed. Stores with long network distances with long network latencies the possibility is to have a standby server more close to the stores with better network connectivity.

2.10.18 Need of a test environment for future enhancements and releases

After the first rollout it is highly recommended to set up a test environment for future functionality and integrations tests with retail store application, and other dependent applications and systems.

2.10.19 Update documentation

During and after the solution has been implemented there will be a need to update system configuration documentation, system application design documentation, system support documentation and system management routines and documentation to support the new functionality and service. This is according the companies processes Service level management and life cycle management.

2.11 Consequence Analysis

There will be changes in retail store physical database design and work routines for the retail store application. The changes should be implemented in project form in an implementation project within retail store application development and support.

2.11.1 Impact on Roles & Responsibility and organizational setup

The pre-study team in recommends, after consulting with the responsible architect and the product responsible for current retail systems, that the new solution will be a part of the retail store applications as an extra retail store functionality and service. This will enhance faster consistent support for future support activities, and because the solution will be closely dependent to retail store.

When implementing this solution an Oracle RDB DBA is needed. This function can be in the GDBA production support unit, or it can also resides as a part of GVMSRET group as a part of the retail store application OpenVMS platform. There will also be a large need of DBA competence within the retail store application development and support in the area of database design and implementation design for future solution development.

Users to be able to benefit the new report solution they must be informed and/or trained how to use the new reports provided with the central retail report solution.

2.11.2 Impact on IT Systems

As written in previous chapters in this report there will be changes and impact on retail store application and database when implementing both the central report solution as the standby solution. An efficient transition and change process will secure the implementation involving all affected stakeholders.

2.11.3 Impact on implementation process

Service desk, retail store application support staff, and retail store operation support needs to be trained in solution concept and management before the solutions are tested in pilots and implemented.

2.12 Reporting tools

The goal of the solution is to deliver accurate retail business data in time to the business for reporting. The chapters below describe the tools selected by the company as reporting tools alternatives for the central retail reporting solution.

2.12.1 WinGADD

There are needs for business reports from dependent project. [4]WinGADD is used today as a common report tool in retail store. There will initially be reports available when starting the central retail reporting solution. The report tool will connect to the Central Retail reporting database in the same way as to a retail store system. The reports have not been tested during this PoC but will be tested during the pilot.

2.12.2 Cognos

[1]Cognos is selected by the company as the main report tool. There have earlier been problems to connect Cognos to retail store. Cognos report tool was not compatible with Oracle/RDB 7.2 databases. To implement Cognos reporting functionality the changes to be done in Oracle/RDB 7.3 needs to be further investigated and also test the tool against the central retail report solution.

2.12.3 QlikView

There is a wish from the business to also be able to use [9]QlikView as a report tool. QlikView is suggested as a future optional report tool to be used in the central report solution where there is a need for prototyping and analyzing data.

2.12.4 Recommendation

The project recommends that the WinGADD reports in the pilot also are implemented in Cognos and QlikView to see if those two reporting tools are compatible with the Oracle/RDB database environment, but also to verify that they run with same result and approximately the same performance as the WinGADD reports.

2.12.5 Decision about reporting tools

The decision which report tools that can be used in this solution will be decided after the pilot has been performed. The project needs to test and verify WinGADD, QlikView, and Cognos report tools are compatible with the solution in a production environment.

3 Solution alternatives

3.1 Use the JCC LogMiner Loader to load an Oracle/ RDBMS database

The JCC LogMiner Loader tool [see Appendix 1] can replicate to other databases than Oracle/RDBMS version 10 or version 11. This has been discussed earlier. Following benefits and disadvantages have been investigated compared to the current proposed solution:

Advantages:

+ The company has more in-house competence within UNIX/Oracle environments comparing to OpenVMS/Oracle RDB environments.
+ It is a company strategic direction to select Oracle/RDBMS solutions where version 11 is the current supported version.

Disadvantages:

− A separate Unix/Oracle RDBMS environment is needed and cannot share a common environment with the Hot Standby solution.
− The JCC LogMiner loader has still to run on an OpenVMS environment where as the database connection has to be over the network during load. This will be slower with more network load comparing to load the data on the local OpenVMS server.
− There are some restrictions in areas such as
  - Data types
  - Reserved words such as table names.
  - National Language support
  - Trim and NULL interpretations.
  - Timestamps other than Timestamp(7)
  - Date time in the Key
  These restrictions must be investigated thoroughly and the data not supported have to be migrated in the source database, or converted during the replication if possible. This will demand more resources from retail store development and longer time to implement the reporting solution.
− No cost savings. The company still has to have a central environment and JCC LogMiner licenses.

3.1.1 Use JCC LogMiner Loader on the local retail store node and load over the network.

The pre-study also tested to run the loader over network to a remote target which can be an ORACLE/RDB or Oracle/RDBMS database. SQL Server 7.3 connections were used and the time to update the central database became at least 3 times longer compared to updating a local database.

When having an update over a WAN connection from SPAIN the update times were 100 times longer. Conclusion is that this option is not possible at the moment because of the amount of nightly batch updates and the network performance in some countries.

To use the JCC LogMiner Loader to remotely load a target the solution should be tested in every specific proposed connection. Tests should compare the time to copy files and load them locally compared to when the loader updating the data remotely from the central server. The differences between daily operations and nightly batches have to be considered.

There are also to consider a JDBC connection if this scenario is going to be used. JDBC is more efficient handling transactions over the network than SQL net connections. This option is possible to implement later as a complement to the current solution where there are sufficient network resources.

This option will not decrease the investment in licenses or hardware. There may be additional work to develop or modify procedures for implementation and support.

3.2 Use the Oracle RDB LogMiner and develop a company customized LogMiner loader

This alternative uses the [2]Oracle RDB LogMiner functionality to extract the changes in the retail store database at the store and send it over to the central server and update a central database with a homebuilt developed LogMiner loader. The concept will be the same as in the primary solution but the company has to develop a company customized LogMiner loader.

This solution needs Oracle RDB LogMiner development with senior RDB competence and will probably need to be supported by the company as a new solution instead of as a bought service.

This solution will also have to solve the same issues like to have to send AIJ transactions in files through the network, because the AIJ information is not available on the Hot Standby databases.

Advantages:
+ Lower license costs and business risk
+ Uses the same hardware & technique as our primary solution.
+ Company owned solution
+ All competence about the solution exists inside the company.

Disadvantages:
− customer customized solution instead of bought solution
− Reinventing solutions for example Virtual columns, Transaction synchronization etc.
− Needs more development, maintenance and support from the company IT department.
− Direction is to buy development as service, not to build in-house solutions.
− Needs senior Oracle RDB development and management competence which can be hard to find. JCC may not be available while the company is not buying their product.
− High risk that the company needs to handle Oracle RDB LogMiner issues which JCC already have solved.
− Still have to use the network to copy AIJ transaction information to update the databases on central server.
− Risk for low quality in the beginning because of lack of experience and competence in Oracle RDB and log mining.
− Longer time to develop, test and rollout needed.
− It will need more in-house developed maintenance routines, monitoring routines and log checks.

3.3 IDRS agreements sending report data

An alternative solution to use data replication is to use IDRS agreements to send report data to a central node to update a report database. The solution demands development resources to plan, develop and maintain an IDRS agreement solution from both retail store development as IDRS support organization.

Advantages:
+ Savings in JCC LogMiner loader license cost

Disadvantages:
− Approximately 5% more resources and time must be allocated in retail store development compared to JCC LogMiner Loader solution. The higher percentage is calculated by current retail system responsible

together with JCC experts and the pre-study team. It is based on former experiences in setting up new IDRS integrations within the company.
- Risk for longer implementation of the central reporting solution due to lack of resources and other retail store releases.

3.4 Use RMU/UNLOAD and RMU/LOAD into a central database from Hot Standby back up databases

This option is about unload complete table data from [3]Oracle/RDB Standby databases and load it into a central Oracle/RDB database which may consist of one or more databases country databases depending on the best database design to support the reports. The solution needs Hot Standby databases to unload data.

It will also need creating of new retail store views for reports and extract data. This option has a limited timestamp functionality only to take the timestamps from the Hot Standby database to be used in report database.
Since this option reloads ALL table data on regular basis which means this solution will be volume dependent. Care has to be taken when using triggers and foreign keys when unloading and loading data.

Advantages:
- + Lower license costs
- + Solution will not use network when unloading and loading data.
- + Uses the same hardware and technique as the primary solution.

Disadvantages:
- Risk for performance issues when reloading all data. Will be slower and slower as the number of tables, number of stores, and the table data volume increases. High risk in the end that this solution will not work on high volumes.
- There will be risk of database locking when reloading data due to reports.
- Large volumes of data have to be handled because it does not update the tables with changes, and tables have to be reloaded with all data every time.
- There will be a need of more scripting and routines developed by retail store development since no bought ready application to install.
- It will need more monitoring and log checks.
- More time for investigation, and solution design is needed which will cause a roll-out delay.

The project sees this solution only as a temporary solution which can be used during the time to develop a permanent solution due to low performance and volume dependencies.

3.5 WinGADD

WinGADD is a temporary solution already in use and could only be used to survive and win time to bring forward a permanent solution according to the company IT architects due to long term BI decision not use [4]WinGADD in the future. Reports can be executed on country level. It will not work on regional or global level due to high risk for data fetch locking. WinGADD solution will connect directly to the store´s retail databases to collect the data. If one of the store databases is not available the fetching of data will stop for all stores.

Disadvantages:
 - Cannot connect a large number of servers due to the risk of connection failures, due to network problems.

3.6 Oracle RDB replication option

Oracle RDB replication option is an [2]Oracle RDB product for replicating data in RDB databases to other sources such as another Oracle RDB databases. This product is different in how the replication is performed. It can replicate as JCC LogMiner Loader tables, and columns selected by the user. Differences [see appendix 2] are that this product uses internal tables created by the product to handle the transactions while JCC LogMiner loader uses the AIJ files as table data source.

Advantages:
 + Easy management (SQL commands to manage the replication).
 + Oracle product, license included.
 + Can be managed centrally and is done using a central transfer database where all definition for the replications are stored.
 + Can replicate to more than one target using connectors.

 Disadvantages:
 - More changes to the source database compared to if using the JCC LogMiner Loader solution. The product creates it owns tables for keeping transaction data and modify tables which is replicated.
 Example:
 Tables added are RDB$TRANSFERS,

RDB$TRANSFER_RELATIONS and RDB$CHANGES_MAX_TSER.

- Maximum of 20 simultaneously replication operations can be run at the same time.
- All transactions in the source database have to be written twice for information in replicated tables. This can slow down and load source database.
- Replication management tables needs to be maintained regularly not to slow down the replication performance. Example: RDB$TRANSFERS table will be fragmented.
- Only transaction based network update available. There may be network performance issues causing slow updates in central database.
- No Virtual column functionality as in JCC LogMiner Loader, Store specific columns has to be created in source tables.
- When two or more transfers write concurrently to the same target tables, access conflicts or deadlocks can occur. There are two ways to deal with this:
  - Schedule transfer execution so that only one transfer writes to the target tables at a given time.

  Or

  - Enable checkpoint restart in each transfer's definition. This is done by adding the CHECKPOINT clause to the CREATE TRANSFER statements. Or you could add the CHECKPOINT clause later by using the ALTER TRANSFER statement. The checkpoint option does not prevent access conflict or deadlock errors; it permits transfers to recover from such errors and continue execution.
- It will need more monitoring and log checks.
- More time and resources for investigation, and solution design. This will cause a roll-out delay.

4 The author´s recommendation to the company

- The author recommends the company to implement the solution based on JCC LogMiner Loader. This solution is the most suitable solution since it fulfills long term needs and is approved by IT architects.

- If the business risk cannot be minimized, eliminated, or JCC solution is not an option to the company, the author propose that the company develop a customized LogMiner Loader solution. This solution will take longer time to design, test, and implement.

- If more time is needed to negotiate contracts between the company and JCC Consulting Inc., or another solution is chosen, the author recommends that the current reporting solution, WinGADD, is prolonged as a temporary solution. WinGADD is tested and requires less development.

5 Future work and possibilities

The recommended solution is based on the company IT architects roadmap [see fig 10]. The IT landscape roadmap is a long term view of how to develop the system landscape so that it will be possible to adapt to new integration solution, sustainable and maintainable. In this picture [see fig 10] the recommended solution is shown as an integrated part of the operational data system. The authors recommended solution goes in hand with the roadmap and at the same time gives possibilities for further improvements and cost savings. These are perceptions and observations important to the company.

Below possibilities proposed by the company solution analysts can by this be fulfilled.
- Reduced batch time by moving outgoing integration and lists to regional database:
  → One step closer to 24/7 availability
    → Shorter downtime for solutions in the warehouses
- Replicate data from production to test environment for improved test quality
- Less risk for database locking
- Integration from central node instead of ~300 nodes possible
- Failover possibility if local server goes down or for maintenance
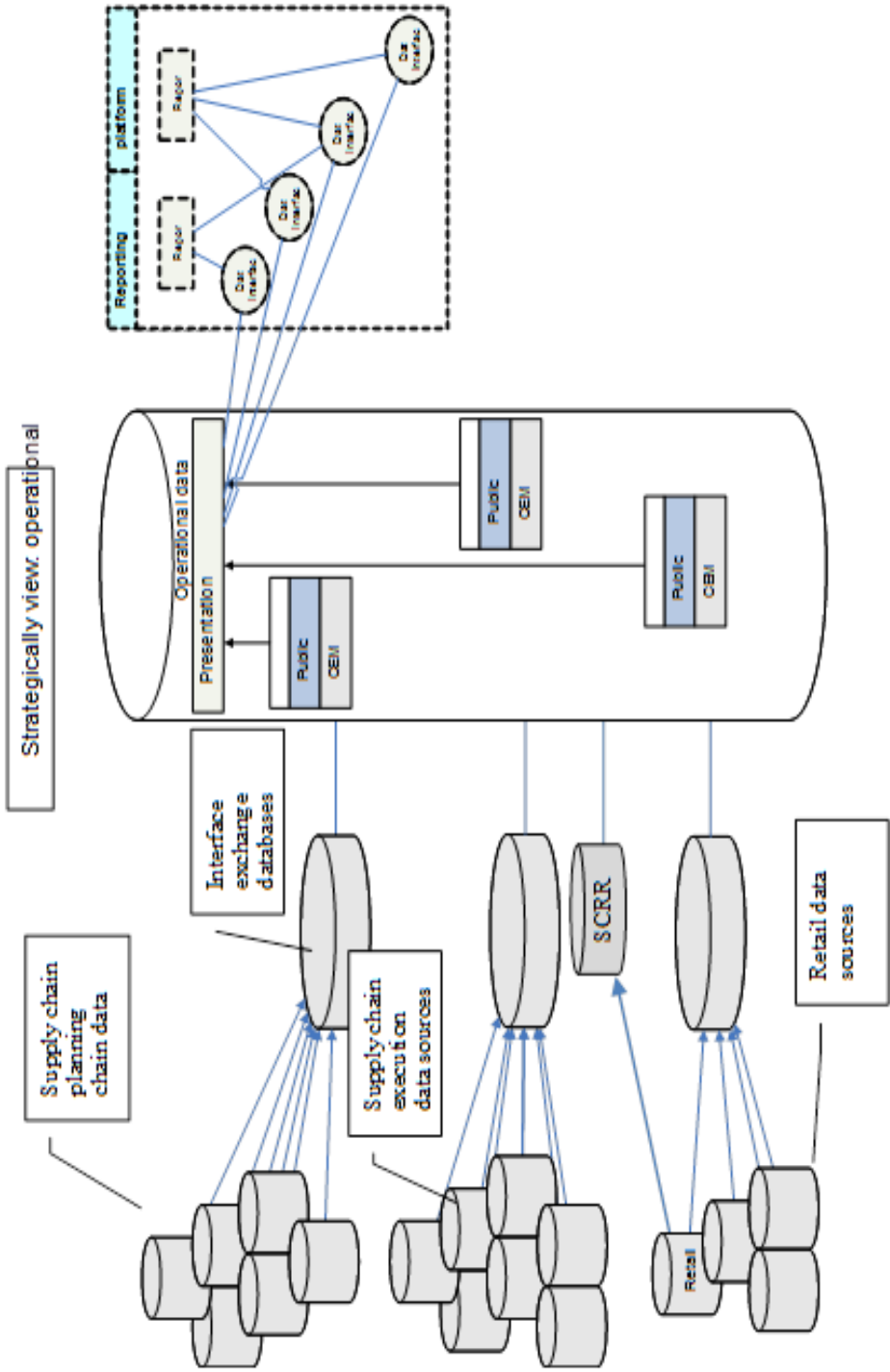- **Strategically overview**

Strategically overview

Figure 1: IT landscape company roadmap

6 References

1. http://www-01.ibm.com/software/uk/analytics/cognos/cognos10/reporting.html (2012-10-03)

2. http://download.oracle.com/otndocs/products/rdb/pdf/tech_archive/intro_rdb_logminer.pdf (2012-10-10)

3. http://download.oracle.com/otn_hosted_doc/rdb/pdf/rdbrn_711.pdf (2012-10-10)

4. http://www.gaddsoftware.com/index_en.html (2012-10-10).

5. http://www.jcc.com/products.htm (2012-10-02)

6. http://www.oracle.com/technetwork/products/rdb/hotstandby-098401.html (2012-10-01)

7. http://www.oracle.com/tec hnetwork/products/rdb/overview/index.html (2012-01-02)

8. https://www.ppsonline.se/demo/disp/sv/standard/role/pm_mini/roleentrance/id.html (2012-10-01)

9. http://www.qlikview.com/uk/explore/products/empowers-it (2012-10-10)

10. Runeson P. & Höst M.Guidelines for conducting and reporting case study research in software engineering 5.2.3. (published online 2008-12-19: http://www.springerlink.com/content/t22r8l65q7h31636/

11. Tonnquist, B. (2010). Project Management. Stockholm, Sanoma Utbildning.

12. Yin, R.K. (2002). Case Study Research: Design and Methods, -3rd ed. (page 34, fig 2.3) UK, Sage Publications, Inc.

7 Appendix

1. JCC LogMiner Loader Workshop (copyright 2002-2010), JCC Consulting Inc.

2. Oracle Rdb: Replication Options Overview, Oracle New England Development Center (copyright 2003), Gettys, B.