UBC SEEDS Database Interface Project - Final Report

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UBC SEEDS Database Project
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To Whom It May Concern:

Enclosed in this report are the results from our analysis of the inter-business processes of Campus & Community Planning, Land & Building Services and Classroom Services. Our report contains the following:

- Executive summary.
- Table of contents.
- Description of the organizations involved.
- Description of the current processes and system.
- Description of problems with the current system.
- The alternatives considered to solve these problems.
- Our recommendations.
- Support documentation and appendices.
- A detailed project plan for implementation.

Thank you for your time and participation in this project. We hope that the information presented here will enable you to make an informed decision on how your business processes can be optimized.

Sincerely,

Logan Hoffert	Tracy Anderson	Allan Tang
Tom Chen	Terence Lim	Jennifer Ip
Kelly Macauley	Aleem Nathwani	Gabriella Wan

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Table of Contents

Executive Summary

The purpose of the UBC SEEDS Database Interface Project was to find a way to integrate data so that it would be consistent between the three organizations, Land and Building Services, Classroom Services, and Campus and Community Planning.

To begin with the project, the business processes of these organizations were identified and mapped out into process diagrams. The diagrams represented the flow of how procedures were completed.

Organization description, as well as an information system description was completed for each of the departments. We identified what each department was responsible for and what software was currently in use.

Two problems were the major focus in this project: lengthy response time for classroom booking and data inconsistency. We proposed a solution to reduce this response time by altering the access rights to Classroom Services' Ad Astra program. After analyzing several alternatives, we have decided that a middleware solution would be the best fit for UBC to eliminate data inconsistency. A few companies were contacted and information on what services they provided and cost were gathered, and finally Data Junction was the company selected. Company selection was based on a match for what the company offered and what was needed by the University, as well as a reasonable cost of implementation.

Feasibility and a cost-benefit analysis were completed to determine the possibility of integrated a middleware into the UBC system. Furthermore, we have included in our analysis a brief overview of a including a firewall that may play a crucial role in protecting the UBC databases from unauthorized external users. To conclude the project, a project timeline is also provided to give the organizations guidance into the full implementation of middleware.

Introduction

The UBC SEEDS Database Interface Project is a project attempting to improve the quality of and access to information of three of UBC's departments. These departments are Classroom Services (CS), Land & Building Services (LBS), and Campus & Community Planning (C&CP). All of them have some interest as to what buildings exist on campus and how they are used. The three departments have three separate databases keeping track of data regarding the rooms and their usage. As might be expected, there is a great amount of data inconsistency between these databases. In addition, there are some concerns about how maintenance scheduling is done and how security is handled. The purpose of this project is to formulate a solution that will reduce data inconsistency and improve data communication between the three departments in relation to building and room data and ad hoc bookings for maintenance and security of the information. As these three problems are independent of each other, the report will be divided into four parts, with each part discussing a problem and solution and the last part discussing the implementation plan. All other parts of the departments not relating to this are deemed irrelevant and will not be discussed here.

Organizational Background

1. Land and Building Services (LBS)

Organization Description

Land and Building Services is responsible for campus facility maintenance. Services such as construction, renovations, and repairs of all the land and buildings of UBC are all apart of this department's major responsibilities. They are also responsible for preparing UBC's Official Community Plan and Goverance Study, which is used as a foundation for all development, land use, and transportation activities on UBC.

Information System

The department originally used Novell software, but was no longer sufficient enough to serve the University's standards of data management. The software has now been replaced since

September 2002 with the software solution called Facility Focus (FF). Facility Focus has integrated functionality, which includes services such as:

- Work management
- Estimating
- Inventory and equipment management
- Space planning/CAD integration
- Construction and project management
- Standards and benchmarking
- Property portfolio analysis
- Purchasing and contracts
- Personnel and labor force management
- Preventive maintenance
- Utility management

This software tracks work orders, assets, maintenance, renovations and cleaning for LBS. This in turn has allowed LBS to automate and integrate all their existing facility management, asset management and maintenance management.

This software is used in approximately 70-80 universities and UBC is the first Canadian customer. Also, since there are over 200 users who have been trained to use the software, which has about a 2-year time requirement for its implementation, alterations and customizations will be expected to continue.

2. Classroom Services (CS)

Organization Description

Classroom Services has the task of scheduling class space for each course. They are in charge of allocating classrooms in an efficient manner as well as exam schedule planning (in terms of classroom allocation) and maintaining information regarding classroom capacity, occupancy, etc. Their main function is to ensure efficient utilization of campus space which in turn maximizes

campus usage. In addition, CS also acts as a consultant regarding the utilization patterns of space for UBC periodically analyzing and generating reports to submit to the government, from which it receives most of its funding. Therefore, CS is dependent on accurate, assessable and up-to-date information.

Information System

The Classroom Services department retrieves information from the Student Information System (SIS), which was a central database that ran on the Oracle Server. The SIS maintains all information to assist the data entry clerk. Information includes student numbers, personal info, course numbers, etc. The SIS is the biggest database in UBC. However, the information contained in the database system proved to be inaccurate because data was not kept up-to-date. CS went on to using a new software solution that is currently under use, called Ad Astra. This software completes course scheduling duties. It serves approximately 250 users via the Internet, where departments and faculties log on to utilize the scheduling function. The authentication measures currently in place are strictly enforced. Furthermore, there are two uses of information. The first is for classes such as where, when, and how many students. The second usage is for generating reports on how well space is utilized. It is extremely vital for data to be accurate and consistent because UBC receives funding for capital projects from the government based on space utilization.

3. Campus and Community Planning (C&CP)

Organization Description

Campus and Community Planning is a department of Land and Building Services (LBS) and it controls database and access. This department holds campus wide space and facility information. Simply put, Campus and Community Planning department is the "accountant of space" by keeping records of who is using what on campus. They are responsible for planning and managing the development of UBC's land area of 402 hectares. Also they ensure that development meets guidelines for land use and area planning.

Information System

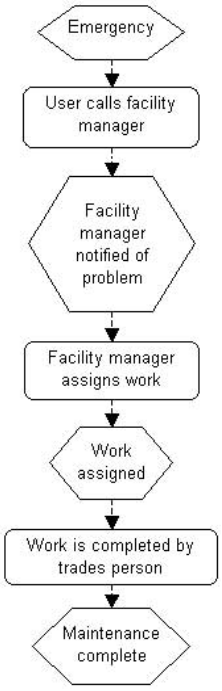
The UBC Space Inventory Database (SID) was originally designed using a software program called D-Base. However, the database has since been transformed into a relational database using Microsoft Access. The database in located in a server, and uses can access information from a remote PC. Land and Building Services and Classroom Services do not have access to this database, they must contact the Campus and Community Planning administrator to retrieve information, or to request any changes or updates to data. Each faculty has their own contact person and a backup is made onto the UBC server every night.

PART I: Maintenance Scheduling

Maintenance Request Process

As illustrated here (and in more detail in **Appendix A**), the maintenance process begins when a user determines a maintenance problem exists, and needs to be addressed. A user in this case is defined as an undergraduate office, department office or dean's office. Once the problem requiring maintenance is identified, the user determines whether the problem is an emergency (e.g. a gas leak) or not an emergency.

Figure 1: Process A



If the problem is in fact an emergency, the user contacts the facility manager of the building the problem is located in. The facility manager immediately assigns the work to a trades person who completes the maintenance required to deal with the problem.

Figure 2: Process B

On the other hand, if the problem is not an emergency, the user calls the trouble line, and the operator records the problem information, including building name, room number, contact name and description of the problem. The operator must then decide if the problem needs immediate attention, or not.

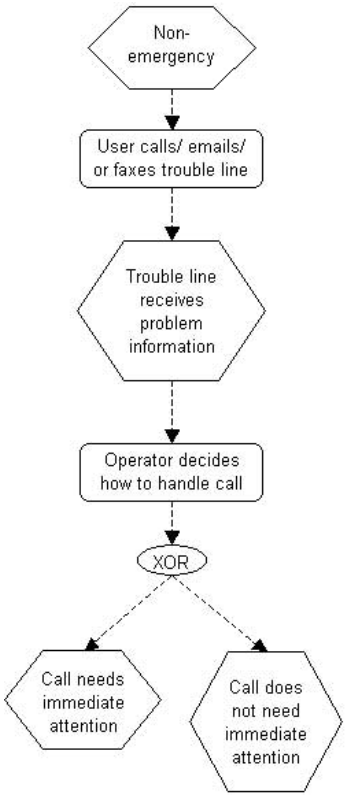


Figure 3: Process C

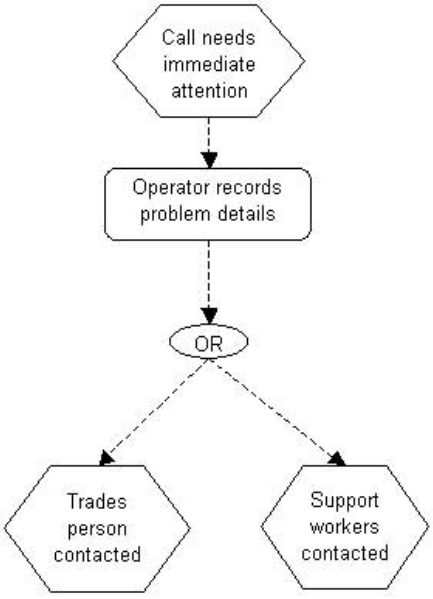


Figure 4: Process D

If the problem needs immediate attention (e.g. water leakage), the operator contacts the maintenance person directly, by paging them, as well as any support workers needed, such as custodial staff.

If the work does not need immediate attention, the operator fills out a Work Request form. This form includes work order number (for tracking purposes), contact name, building number, cost, who is being charged, zone number and associated facility manager, description of the problem, and when the work order was entered into the Facility Focus system. The work order is sent over the network to the printer of the appropriate facility manager, where it is automatically printed. The facility manager receives the work order and determines if the problem is located in a classroom.

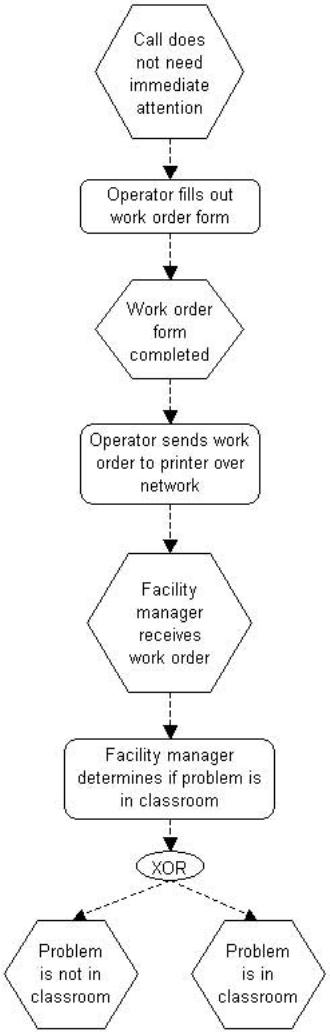


Figure 5: Process E

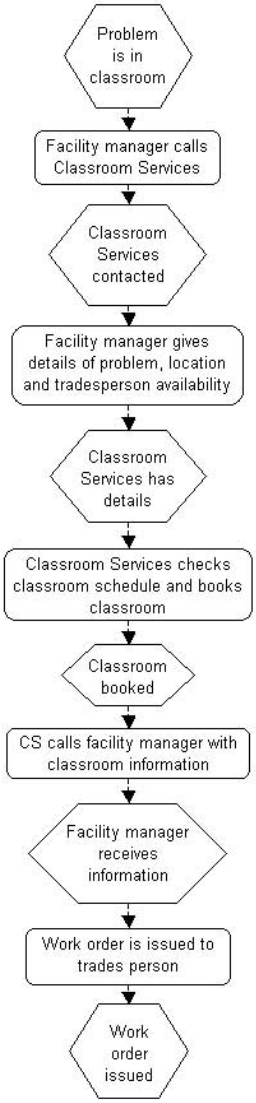


Figure 6: Process F

If the work requested is in a classroom, the facility manager calls Classroom Services and relays details of the problem at hand. Classroom Services checks the classroom schedule and books the room. Thereafter, Classroom Services calls the appropriate facility manager back with all relevant information pertaining to the maintenance request. At this point the work order is issued to a trades person. Once the work order is issued, the trades person performs the maintenance requested.

When maintenance is complete, the trades person working on the room signs off the room as "job complete" and closes the work order. The maintenance person gives the work order to his/her foreman, who takes the work order to Work Control (part of Plant Operations).

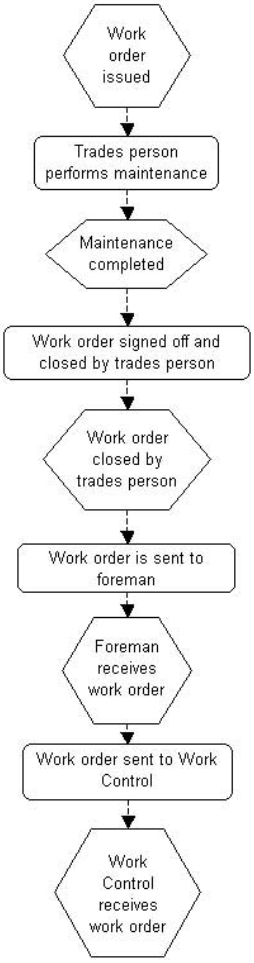


Figure 7: Process G

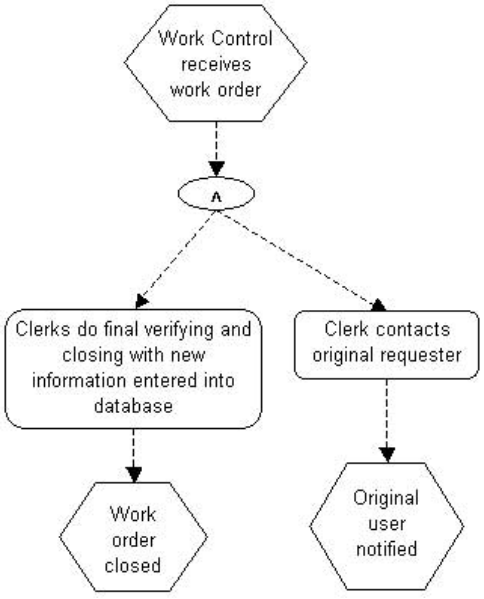


Figure 8: Process H

Clerks in Work Control carry out the final closing of the work order, by verifying work order number and details of the work carried out. The process is then complete! The original requester is contacted and informed that the maintenance has been completed.

Ad Hoc Booking Description

Ad Hoc Bookings are events that are not part of any academic courses that regularly scheduled for meeting times (such lectures, tutorials, labs). These Ad Hoc Booking events include club or department meetings, conferences, AMS club functions, etc. Priority for classroom bookings is given to credit courses, then academic activities, then to general activities.

Currently, only faculty, staff and representatives of a club listed in the classroom services database can make bookings. Students that are not listed in the CS database must get someone who is registered to make a booking for them or else apply for being a booking representative of a club or faculty.

Bookings must be made via email, phone, fax or in person. The follow information is required for a complete booking application process:

- Applicant's name
- Department name or club name
- Submitted request date
- Phone number
- Fax number (optional)
- Email address
- Name or type of function being held
- Date
- Starting time
- Duration
- Capacity, building, room number
- Specific requirements

When this information is provided, Classroom services can search the database for room availability. When a match is found, the booking is made and a confirmation letter is sent via

email. (Response is usually the same form of the request. For example, if you request by fax, then confirmation letter is sent by fax). This reply process takes between 2 to 3 days.

Problem

Currently there is an area of inefficiency in the maintenance request process. The functions highlighted on the right are where this inefficiency exists, and they occur when a facility manger must make a booking to perform maintenance in a classroom. First Classroom Services must be contacted and given details of the problem, its location, and the availability of a trades person. Classroom Services must then check their schedule and determine a time when the classroom can be booked. Then they phone the facility manager who originally requested the booking, to give them the details of the booking that was eventually made. This process can take days if several phone calls must be made to coordinate class schedules with trades person availability.

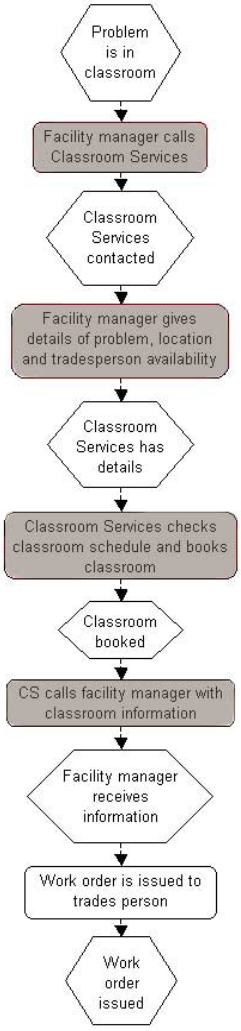


Figure 9: Process F Inefficiency

Solution

If Land and Building Services were given access to Ad Astra, lengthy process time could be eliminated. Instead of employees at Land and Building Services trying to contact the appropriate authority at Classroom Services and book a room for servicing, they could fill out a Work Request form (as soon as a request for servicing or maintenance is received) in their Facility

Focus application, then use the Ad Astra application to reserve the room. This process that normally takes from 2 to 3 days could be shortened to virtually a couple of minutes.

Once the new Ad Astra account has been set up for Land and Building Services, the maintenance request process is simplified and shortened (illustrated on the right, and in **Appendix B**). It is more efficient, as facility managers can access the classroom schedules themselves in order to make bookings. There is no need to call Classroom Services, so the time that is normally spent making phone calls, and waiting for replies, is eliminated.

Much of the maintenance request process remains the same, starting with a Work Request form being filled out in Facility Focus. The change occurs where Plant Operations (LBS) would normally call CS to book a room for maintenance. In the new process the facility manager opens the Ad Astra application, checks the schedule and books the room, without ever having to call CS.

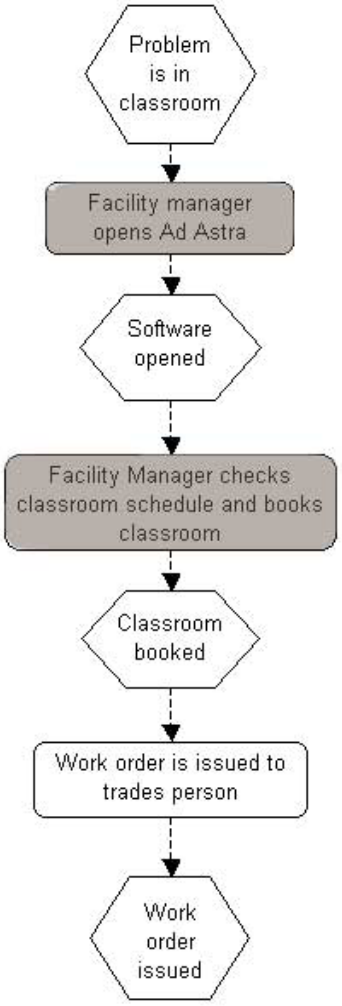


Figure 10: Revised Process F

Feasibility

Benefits

Giving Land and Building Services access to Ad Astra eliminates following steps:

- Facility Manager calls Classroom Services.
- Facility Manager gives details of problem, location and tradesperson availability.
- Classroom Services checks classroom schedule and books classroom.
- Classroom Services calls Facility Manager with classroom information.

The above steps are replaced with the following:

- Facility Manager opens Ad Astra.
- Facility Manager checks classroom schedule and books classroom.

By eliminating the phone calls that must normally be made, LBS and CS will significantly reduce the amount of time needed to book a room for maintenance.

Costs

As no new software needs to be purchased, there are no external costs. Giving LBS an Ad Adstra account that allows them to schedule bookings and training will also take very little time to implement. It is estimated that it will take an hour to create/modify the Ad Astra account and two hours to train the LBS staff to use the system's features that they require.

PART II: Data Inconsistency

Reporting Processes

There are two main types of reports; space inventory and space utilization reports. Space Inventory reports are conducted for UBC departments, consultants, and the Ministry of Education. Space utilization reports are generated for the Ministry of Education, space planning, and management personnel.

When a request arrives for a space inventory report, the C&CP space analyst extracts the necessary data for the report from C&CP's space database using MS Access. It is then determined if further analysis is necessary. If so, the resulting data is exported to specialized data analysis software, where it is analyzed. Data from the analysis is then exported (cut and pasted) to MS Word. If it is not necessary to do any analysis, the data is imported (cut and pasted) straight into a MS Word document. Once the report is finalized (or checked over), it is sent to the client via e-mail. The following Event-Controlled Processing Chain (EPC) diagram illustrates the process of generating a report to satisfy a request for space inventory.

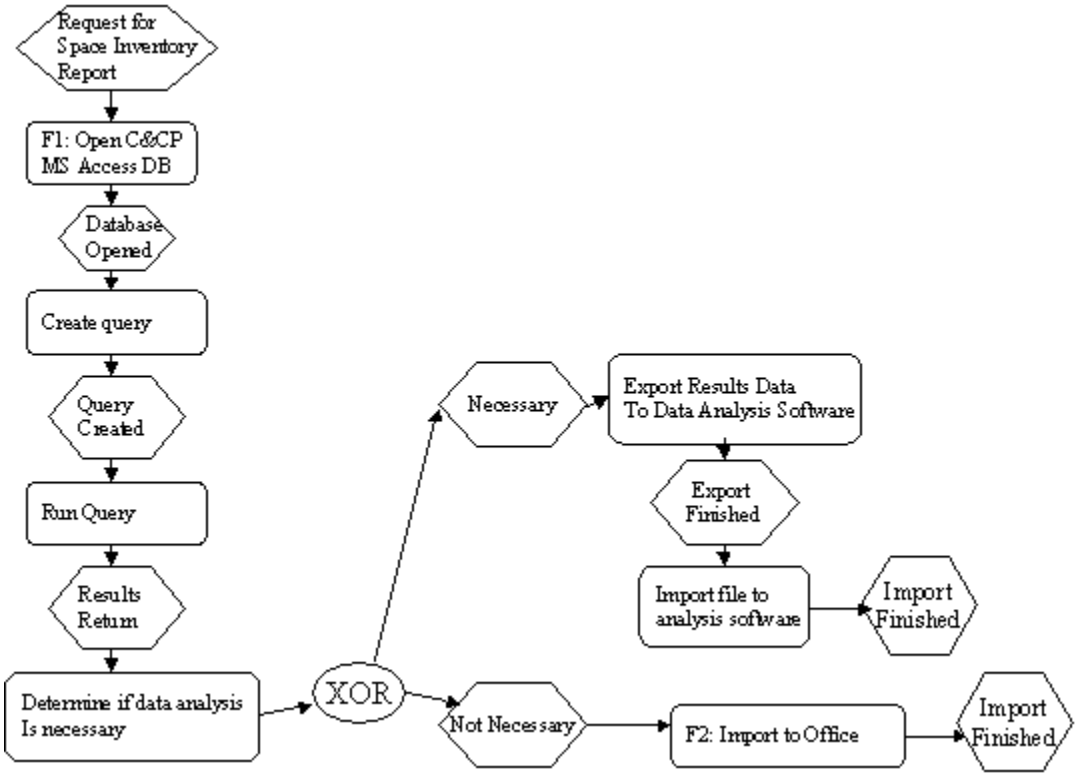


Figure 11: Space Inventory Report Process

When a request arrives for a space utilization report, the C&CP space analyst first logs into CS's Ad Astra database and queries the database using MS Query. He also has to query C&CP's space database using MS Access. The data gathered from these two queries is exported to the data analysis software. Here, the information for the analysis is formed. Finally, the information is exported to MS Word. Once finalized (or checked over), the report is sent via e-mail to the client.

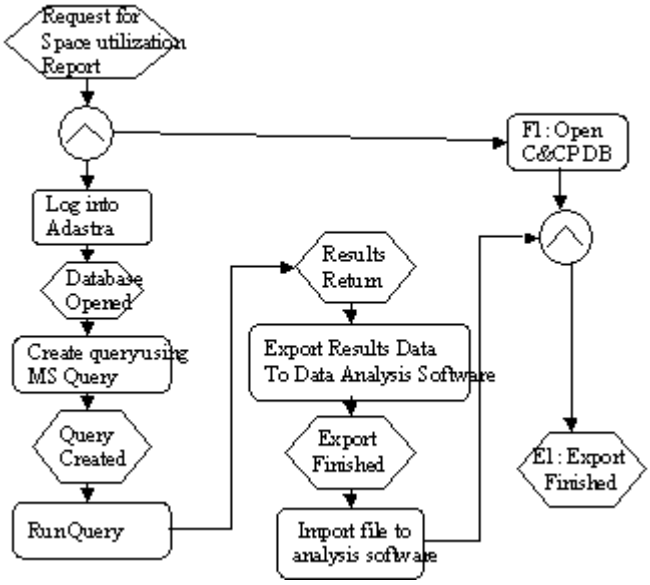


Figure 12: Space Utilization Report Process

As you may have noticed, the processes shown above are not complete. This is because after this point both reporting processes share a common process path. This process path is illustrated in the following two EPC diagrams.

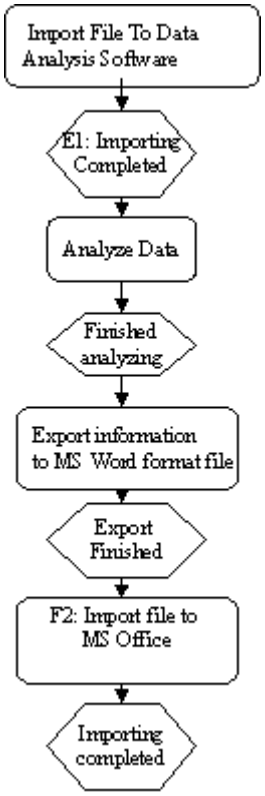


Figure 13: Importing to Data Analysis

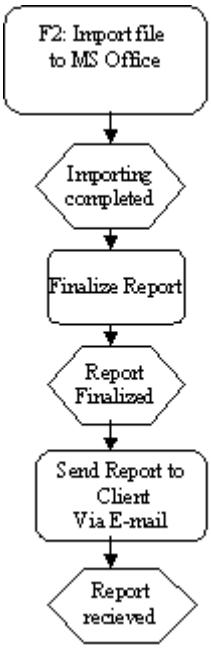


Figure 14: Importing to Reporting Software

The above report generation processes rely heavily on the consistency and accuracy of the data contained in C&CP's database and CS's Ad Astra database. Data inconsistency is the main problem that a space analyst faces when he is producing a report for any client. The root of this problem is that the databases of the three departments (C&CP, LBS, CS) are not linked. This implies that data updated in one database is not reflected in another, and therefore reports generated on this data would reflect this inconsistency.

To address this problem, we decided to consider the effects of a middleware solution. Using this solution, the data inconsistency problem would be solved. By allowing interactions between the three databases, updates in one database will propagate the same changes to related information in another. This will ensure that a space analyst can be confident that the data used in his report is accurate and up-to-date.

Problem

Classroom Services

The main data problem that CS faces is the inaccuracy of information in its database. This inaccuracy is the result of a lack of integration between CS's system and that of the other operating divisions on UBC campus, particularly LBS and C&CP. Because of this lack of integration, CS is often operating with inaccurate details in their database, something that can be quite troublesome considering that CS has to handle ad hoc bookings of rooms for meetings and such, where the person or group booking the room may have special requests for room amenities and seating capacity. Imprecise data can make efficient customer service quite a challenge for CS. Imagine the customer of theirs who books a 20-seat classroom with a projector for a presentation and shows up there to find that there is indeed no projector and that half of the seating in the room has been eliminated. If CS does manage to identify incorrect information in their database, an in-person visit to the site in question is usually required, as the correct room information is discovered. Understandably, making the right decisions to meet users' requirements as well as maximizing campus usage for CS is therefore an impossible task at times.

Land & Building Services

The main potential for data inconsistency in regards to LBS comes from the completion of the work request. Once a room's required service or maintenance has been completed by LBS, they go into their Facility Focus (FF) software application and change the Status field in the Work Request form to Completed and if an alteration has been made to the structure or amenities of a particular room (e.g. a decrease in the amount of seats, or a new facility available in the room), it is up to the person or organisation who initially requested the service to notify CS that they need to update their database to reflect these changes. Evidently, this process makes CS's data integrity vulnerable; as it is quite possible the initial service requester may forget to notify CS of the changes.

Campus & Community Planning

As noted, the key problem with the situation with the three UBC departments is data inconsistency. All the departments need accurate data on the conditions of the rooms, but each department may have its own record of what that current state actually is. There is not sufficient communication between the three departments to ensure that the information in everyone's database is the same. For C&CP, this is a significant problem as it means that the space utilization reports (i.e. data on campus buildings, including what their use is and who has how much building space allotted to them) that they send to the provincial government to obtain funding for capital projects may not be accurate. Obviously, it is important to UBC that these space utilization reports are as accurate as possible, so they represent to the government what is actually going on at UBC.

Database Descriptions

As the purpose of this project is to formulate a solution that will reduce data inconsistency and improve data communication, a clear understanding of each department's database system is hence needed in order to discover where potential data inconsistency may occur, thereby helping to determine the most appropriate solution. A clear diagram describing each respective division's database system is also provided to assist in this analysis.

Classroom Services

Classroom Services uses an application called Ad Astra in their business process, which runs on an Oracle database. The following analysis only includes the tables within that database that are relevant to the room and building data and the ad hoc bookings.

Building -

This table stores information about buildings. In particular, it keeps the code, name, and description of each building. No other data on buildings is kept.

Room -

Information about rooms are stored within this table as it keeps the ID of a room, the building it is in, the name or number of a room, and the contact person to notify about requested use of the room. The table also holds the normal and maximum amount of seats as well as a sub-table that includes the seating types available to the room, such as 'seminar', 'lecture' or 'lab', and each room's special features. In addition, square footage of a room is kept, along with the zone and the region (this information is also held in a sub-table) it is in. The Room table also keeps track of whether the room has partitions, and if so, what rooms those partitions conflict with. Finally, the last modifications and change logs are kept in the Rooms Table.

Block_Master -

This particular table stores information about room blockings such as when a room cannot be used. It holds the blockings ID, the room ID, the start and end dates of the block, the type of the block, and the days of the week that are blocked.

RLAYO_Master -

The different seating configurations of a particular room are stored within this table. The ID of the configuration is held, along with the room's ID, the name of the configuration, and whether it is the default configuration and the maximum seat capacity in this configuration. In addition, this table also stores photographs and diagrams of the configuration.

EVENTREC -

All event meetings are part of a group, and the information on event groups are stored in this table. Within this information, the ID of event groups are kept, as well as an unique reservation code, the name and type of the event group, the customer, and the estimated number of people attending. In addition to modification, pricing and billing data information, EVENTREC also stores the start and end dates times of the event group. Finally, modification and change logs are kept as well.

EVNTINST -

The information on an event meeting is stored within EVNTINST as this table maintains the particulars for a specific instance of an event. It holds its ID, the Group ID of the group that it belongs to, the start and end dates as well as the times of the event meeting, the weekday of the meeting, and the estimated number of people attending. In addition, it also stores the building, room, and room configuration information. Once again, modification and change logs are also kept.

EVENTRES -

The specific resources that are assigned to an event grouping are stored within EVENTRES. It should be noted that other resource tables that support this are not relevant and so are not included in this analysis. The table included its ID, the EventID of the group it refers to, the ResourceID, the days that the resources are needed, and the start and end dates along with the times of when those resources would be needed. Furthermore, the contact name of the person who is in charge with those resources is also included. Again, modification and change logs are incorporated within this table as well.

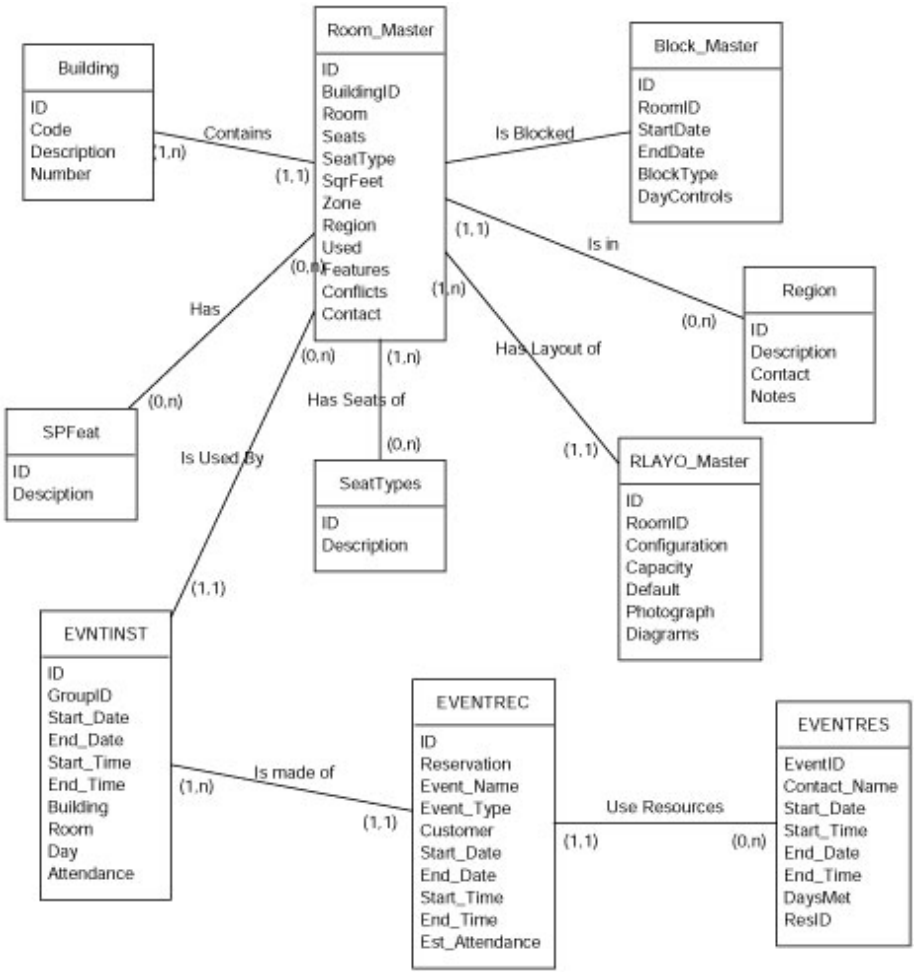


Figure 15: ER Diagram for Classroom Services

Land & Building Services

The background database behind LBS's Facility Focus (FF) application is Oracle. It uses the same set of coding that C&CP uses for buildings and rooms. Only the tables related to the Property Information and the Work Request forms in FF will be explained here.

ae_p_pro_e –

This is the main table supporting the Work Request form. It includes the fields of concern for LBS's servicing process, including "requestor" (Customer on the Work Request form), "proposal" (Work Req), "region_code" (Region), "fac_id" (Facility), "bldg" (Property), "location" (Location) and "status_code" (Status). Of particular interest is the "status_code" field

(Status on the Work Request form), for it is at the completion of an LBS Work Request when this field is changed from “open” to “completed”.

ae_b_reg_e, ae_b_fac_e, ae_s_bld_e, ae_b_loc_d –

These tables store information regarding regions, facilities, buildings and locations respectively. They all support the FF Property Information form and each contain a field that relates to the ae_p_pro_e table: “region_code” (Region Code on the Property Information form), “fac_id” (Facility Id), “bldg” (Property) and “location_code”.

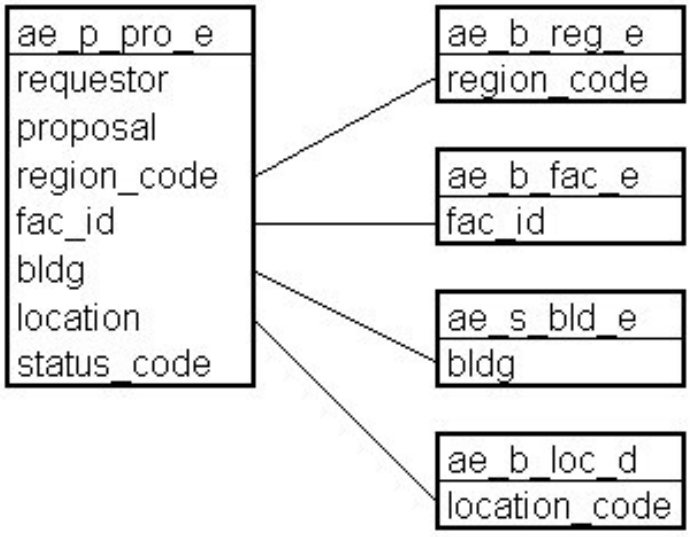


Figure 16: ER Diagram for Land and Building Services

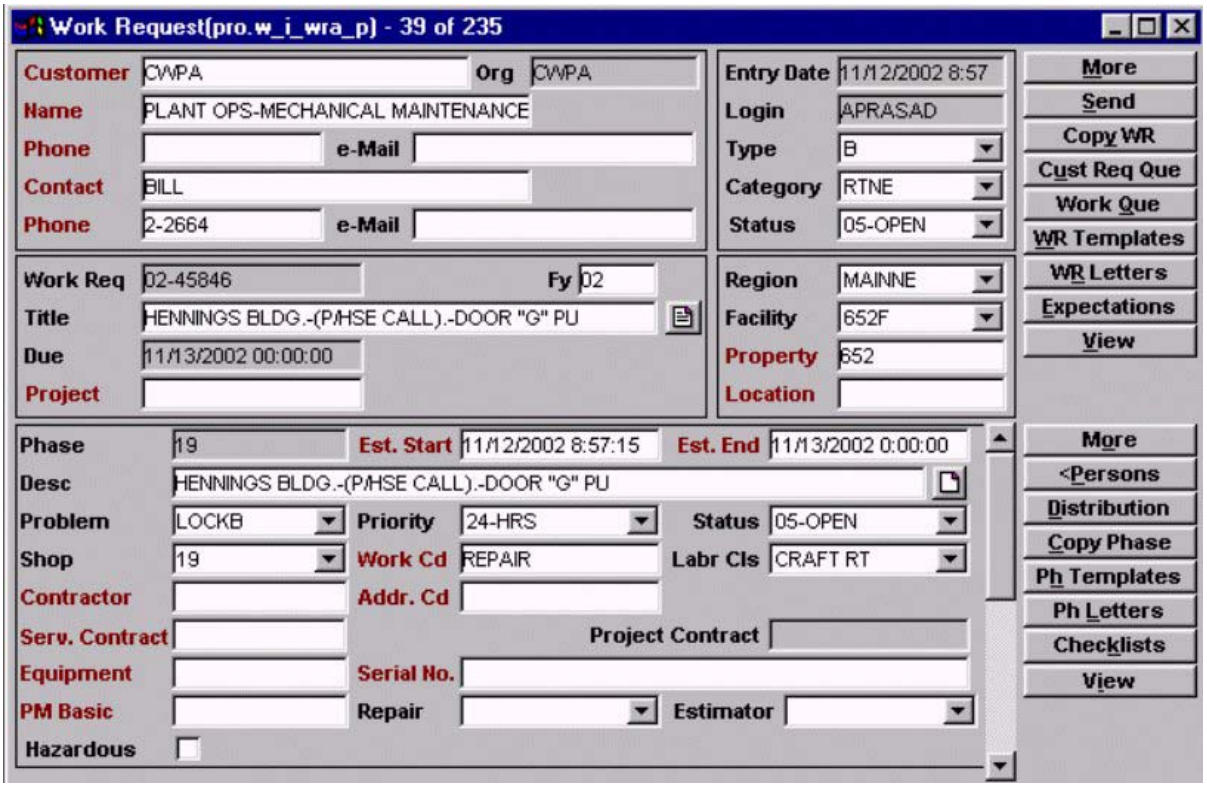


Figure 17: FF Work Request Form (Source: LBS)

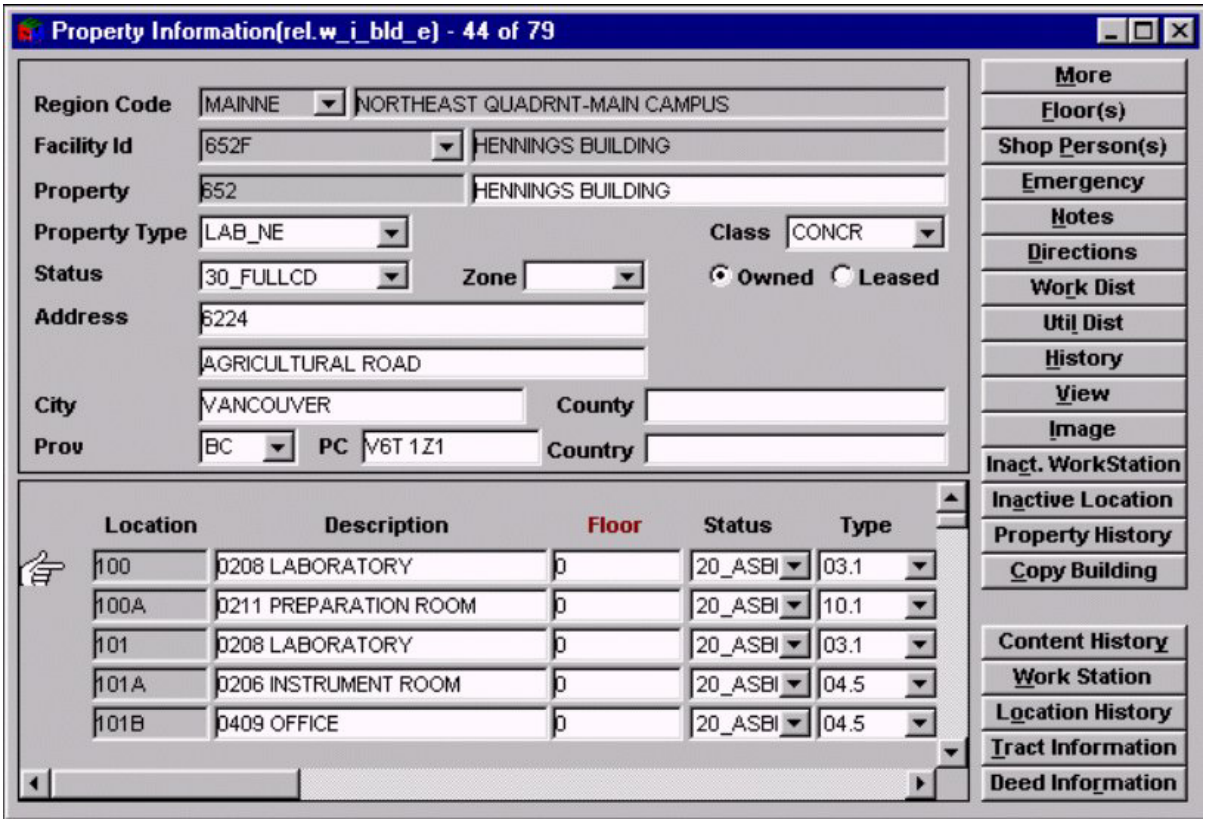


Figure 18: FF Property Information Form (Source: LBS)

Campus & Community Planning

C&CP's database system consists of a Microsoft Access file. The information stored within this database is particularly important for keeping track of data on campus buildings and tracking space inventory. Only the structure of the relevant tables and attributes will be discussed in the following.

Building –

This table stores information about buildings. Specifically, it keeps the building's number, name, and address.

Room –

As there are many rooms in each building, the rooms are uniquely identified by their number. Specific dimensions of each room are also stored within this table.

Space usage –

The concern of this table is pretty straightforward as it deals with which agency is using a particular room and for what purpose it is used for. It should be noted that there are two remaining tables of space usage, detailing the two coding methods used by C&CP. The first set of codes is the set developed by Peter Jia to use for UBC's purposes (including the "Location" field in LBS's tables). The second set is used for all communication with the provincial government. These tables are set up in the ER Diagram in Appendix D.

Agency table –

The agency table stores some data on the agency, namely their contact information.

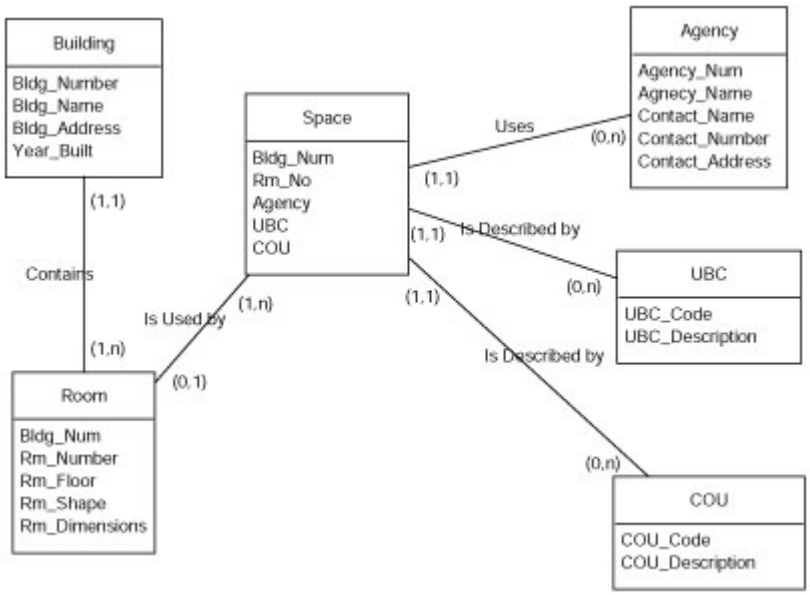


Figure 19: ER Diagram for C&CP

Solution

Alternatives

There are several possible solutions to resolve the problem outlined above. The alternatives considered are:

- **Modify Existing Database:** This solution would modify one of the department's databases (mostly likely LBS's) to include all the data that everyone requires. This database would be consistently updated. The other database systems will access the data they need from the modified one.
- **Obtain Middleware to Link Databases:** This solution would require the purchase of middleware that would interface with all three databases. It would ensure that data is consistent and there are regular updates among them.

There are several flaws with the modifying existing databases solution. The first flaw is that this will make access rights difficult to assign and maintain. The second flaw is it greatly erodes independence between the three departments. The third flaw is that the departments are not

willing to modify their tables in this manner. Because of the seriousness of these three flaws, this solution will not be considered any further.

The middleware solution is much more viable. Middleware is a piece of software that will allow the three databases to communicate in the ways we direct it to. It does not require modifying anything that will interfere with the databases as they are now, but rather can simply run in the background and ensure data consistency.

The requirements for the middleware are that it must:

- be compatible with the databases we are using (Access and Oracle)
- be compatible with the O/S we are using (Windows)
- be focused on integrating multiple databases
- be able to compare fields and communicate with users through prompts, reports or e-mails
- be easy to understand, implement, and use
- cost a reasonable price
- come from a reliable company that will provide support
- come with some consulting and training services to integrate the middleware properly into the current system
- be expandable and scalable

Since these are fairly standard requirements, there are many products out there that would fulfill our base functional needs. As there are many database middleware products and vendors, we need to narrow them down. After a cursory look over several, the four we examined in detail were:

- Mercator at www.mercator.com
- Data Junction at www.datajunction.com
- Prolifics at www.prolifics.com
- iWay Software at www.iwaysoftware.com

After analyzing them further, Prolifics and iWay Software seemed to be focused on selling and supporting IBM's WebSphere, an integration middleware is more geared towards web-enabling databases for e-business purposes and applications. They also have their own products, but these were also e-business focused. Since this is not what we are looking for, these two companies can be discounted. Mercator offers a very comprehensive package that will definitely meet our functional requirements. However, it offers many features that are not needed for this project, and some of those features will cause the middleware to be quite expensive.

Proposed Middleware Solution

As such, we have decided to go with Data Junction, a company based in Austin, Texas. It offers a lot of information about its products including a free trial version, and the products offers all the functionality we need without a tremendous amount of extra features that we do not. Its prices are also reasonable.

Data Junction has been in business since 1985 and has International Distribution Partners around the world. However, there is no partner for Canada, so we need to deal with Data Junction directly. The company has won many awards for its data integration and transformation tools, and has been easy to contact. We are satisfied that this is a reliable company to work with.

Their products support all the programs we are using (Access, Oracle and PowerBuilder/Oracle) and it will be able to perform the specific functions we need them to do. The software provides ways to convert data from one database into that of another after the proper mappings are inputted. It also offers data comparisons capabilities from multiple sources by loading sources into in-core memory and the ability to e-mail or prompt users for more information or with a report of discrepancies. This is what the UBC departments need to ensure data consistency. The products are also scalable and have user-friendly design interfaces. Data Junction also offers implementation services to assist in successfully installing their products. Their products include:

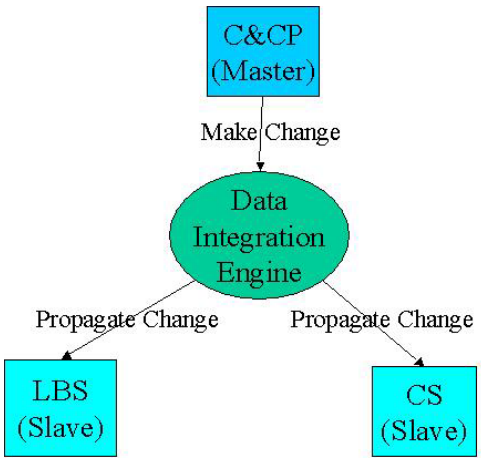
- **Data Integration Studio:** "a comprehensive set of visual design tools for rapidly building and testing data integration processes."

- **Data Integration Engine:** an integration process execution engine that can be embedded in a program. It can also be used to automatically create, map and run default transformations.
- **Content Extractor:** a tool used to capture data from unstructured sources

We will only need the Integration Engine as a bare minimum although the Integration Studio is also desirable. The Integration Studio makes a config file that is subsequently used by the Integration Engine. The Integration Engine can still be used without the Studio, but it will require more internal resources to implement. In addition, if this project is to be scaled to include a more comprehensive integration in the future, the Integration Studio will be needed to perform this. Furthermore, this would reduce dependency on the vendor in case the product is discontinued or the vendor goes under. As the Integration Studio makes the Integration Engine much easier to use and understand, it should be purchased as well. The Content Extractor is not needed at all.

The Middleware will require a Master-Slave relationship to be created using the databases. This means that one database will be selected to contain the master set of information that when changed, will subsequently be changed in the slave databases. Since most of the changes to the databases will be made by C&CP, its database should be the master. Thus, whenever C&CP changes room or building data, that change in their database will automatically be propagated to the other databases. However, if CS or LBS enters some data in their databases after a change by C&CP, the new information will be allowed to override what C&CP entered. The slave databases will still retain their autonomy in all matters except room dimensions and building and room creation.

Middleware-Master/Slave Relationship



Middleware Logic

The Middleware should use the following logic to ensure data consistency between the databases:

- The Middleware would start with a run-through of buildings to ensure that building numbers, zones and regions match between the three databases. It will then produce a report showing any discrepancies. These discrepancies must be corrected by modifying the data to make them consistent or dealt with in other ways such as creating an index that translates maps regions using one set of coding to another before moving on.
- Afterwards, this process needs to be repeated with rooms and their dimensions. The Middleware will then produce a report showing any discrepancies between the room numbers and dimensions. These discrepancies must be resolved before the Middleware can automatically update information for a specific room, as otherwise it will not be able to map rooms from one database to the other.
- After all the mapping has been done, whenever dimensions for a room are changed in one database, the dimensions will automatically be updated in the other databases. This dimensions are stored in the following fields, and thus these fields should always be equal (This may require some modification of the fields or mapping algorithm to ensure they contain the same type of information e.g. should not have 100x100 in one and 10,000 in another):
    - Rm_Dimensions in C&CP's Room table
    - SqrFeet in CS's Room_Master table

- In addition to making the previous changes, changing the dimensions may also result in changing the seat capacity, seat type, configuration, features, or conflicts of a room. Therefore, whenever the dimensions of room assigned for classroom purposes according to C&CP are changed, the user will be prompted to enter the new values for these fields, indicate that they have not changed, or indicate that they do not know. If known, the new values will be updated directly by the Middleware into CS's database. If the user does not know the new values, then the Middleware will flag the related records in CS's database. This will generate a prompt (or e-mail if preferred) to the next CS user that notifies them that there has been a change in a room that could lead to a change its other fields. The CS user should then phone the relevant department and ask them to check the room to get the current room information.
- If C&CP makes a change in a room's purpose from assignable to non-assignable, this should change Block_Master in CS's database to block the room from being used. If C&CP does the reverse, this should unblock the room in CS's database or create and flag a new room record.
- If a new building is built, the data C&CP enters into its database will propagate this to the other databases. These new records will be prompted and flagged in a similar way as described for changing the room dimensions, except this would be for all fields the creating department does not fill.
- If the contact information field in the CS's Room_Master table or in the C&CP's Agency table is changed, the other field should be changed to reflect this. However, there will be a special override for this command if the two departments have different contacts for that room.
- To update properly based on renovations, it may be necessary for C&CP to create a renovation table in their Access database. Currently, there is a danger that a renovation will be performed on a room and C&CP will not have to update its database because it may affect something like the features (e.g. computerized presentation system added to a room), which C&CP does not keep track of. As this would defeat the purpose of installing the middleware, C&CP should keep track of the renovations done in its database. This would involve the creation of a new table called Renovation. Renovation would have a unique ID and would be involved in a one-to-many relationship with the Room table. Its

fields would include Rm_Num, Renovation Start Date, Renovation End Date, Renovation Scale (indicates whether the room is usable during the renovations or not), Renovation Description at a minimum, but can include additional information C&CP feels is necessary. This table would be linked closely with the middleware such that new entries in this table will trigger the aforementioned prompts and e-mails.

The implementation of this logic will be performed using high-frequency batch updates in order to make it close to real-time but considerably easier to implement. Making it real-time would cost much more and would give little benefits and so should not be done.

Middleware Solution Summary

In summary, the middleware will reduce data inconsistency by first mapping or ensuring consistency amongst the buildings and rooms from one database to another. Then it will ensure that when renovations are performed on a room (as entered by C&CP), the middleware will propagate changes to CS and LBS. C&CP will be able to enter the room's new information such as seat capacity if it knows it. Otherwise, CS users will be prompted or e-mailed to notify them that the data for a room may no longer be valid. CS must then contact the relevant department to check how the renovation affects its data. CS and LBS will retain authority over all their data except for key building and room data, including building name, room number and room dimensions. All other data, even if changed by C&CP when they enter a renovation, can be overridden by the department that data belongs to. In other words, if CS and C&CP disagree on the seat capacity of a room, CS's data will have priority. However, if they disagree on a room number, C&CP's data will have priority (unless a mapping algorithm was used instead of changing the data).

The primary effect of this solution will be to completely eliminate data inconsistency as it relates to key building and room data. The secondary effect will be to alert CS (and to a lesser extent, LBS) about renovations that may have changed room specifications such as conflicts, seat capacity or features. This effect will help ensure that the data going into the space utilization reports is accurate.

The middleware will not change the process for generating reports. At the moment, C&CP must make the assumption that the data contained in the databases is correct. The middleware will merely help ensure that the data is correct, which will lead to greater accuracy in the reports created.

Data Junction Contact Information

To obtain more information from Data Junction, please contact Andy Lind of Data Junction. He has been given a brief introduction to this project and its prospects and has been very helpful and cooperative.

Andy Lind
alind@datajunction.com
Director of Business Development, Telecommunication Division
Data Junction Corporation
2201 Northland Drive Sales 800-580-4411 x322 Local# 512-452-6105
Austin, TX 78756 Fax# 512-467-1331

Tech Support 512-459-1308 www.datajunction.com

Feasibility

Benefits

After some deliberation, we decided that we could not acquire enough empirical knowledge to properly define the tangible benefits of the new proposed system. Instead, we resolved to define the intangible benefits of the new system.

The foremost benefit is that the new system will provide timely and accurate information to all users. This means that at any given time, the user can be assured that any information gathered from the database is accurate and up-to-date. This will definitely help to improve organizational planning and allow for faster decision making. In addition, timely and accurate information will help to improve resource control and asset utilization. Also, as a result of the proposed system,

various business processes, such as report generation, will be optimized so that each process is as efficient as possible.

In addition, there is at least one more benefit that was not noted above. Employees will find that they can do their jobs much easier, and with less hassle. This may lead to positive impact factors such as increased staff productivity and decreased clerical errors.

Costs

The pricing is as follows for a single user in US Dollars and includes 1 year of Gold Technical Support and Maintenance (Upgrades). The prices could be adjusted downward to reflect the differences without Support or Maintenance. UBC will need the Integration Studio and Engine, Single-Threaded, as it does not require a comprehensive, multi-threaded program that will be based off different systems. Instead, the software will based locally on C&CP's system, and CS and LBS will barely see the effects except for the e-mails and prompts. This means that the Single-Threaded system should suffice.

	Single-Threaded	Multi-Threaded
Integration Studio	$4,650	$6,000
Integration Engine	$6,000	$11,800

Training costs range from $1,500 for a two-day course at Data Junction to $11,900 for a five-day class at UBC. As the software's user interface, interactive tutorials, and technical support are good, this training should not be needed.

Based on an estimate by Data Junction, the total cost for this project is expected to be 10,000 – 15,000 USD, but this will increase depending on how much training the departments, most importantly C&CP, feel is necessary. Taking the upper end of the range as a more accurate estimate of the total cost, this project should cost $15,000 US.

In addition to the cost of the software purchase, there will also be an opportunity cost associated with the time UBC's IT staff must devote to helping install the system. Since the software must

be installed on C&CP's machines, its two IT staff members should be involved in the implementation. We estimate that they will work part-time on the project, as they still have to fulfill their ordinary IT roles such as maintaining the network. Due to this and the fact that mapping the buildings and rooms between the databases will take some time and require some support from the other departments, we estimate that it will take approximately a month and a half to implement the solution. Training users and gaining and incorporating their feedback on how the new system works is expected to take another 3 weeks. Since the middleware is running in the background, users will not require much training, as the system interface has not changed, only the underlying data. The only exception to this will be the user prompts and e-mails, which simply need to be explained to the users in a two-hour training session for LBS and CS and a for-hour training session for C&CP.

PART III: Security

Security Description

Privacy & Security

Thus far, the organizations have reported that there have been minimal problems regarding security. However, each department holds information that is considered classified information – information that is private to each faculty. For instance:

1. CCP: Space allocation for each faculty. Campus and Community Planning holds all this information, acting as "accountants of space".
2. CS: Exam scheduling for each course. Classroom services holds all information for which exam is to be held at which room, at which time.
3. LBS: Maintenance and Repairs. Land and Building Services hold information on which room requires which repairs.

Potential problems such as hacking and tampering with data may occur and the University should prepare itself for such situations. Any harm to data may result in a loss is costly to each organization. System failure due to external malpractice and system abuse may result in downtime during crucial moments (i.e. during exam classroom scheduling period or when government reports are due).

Solution

Firewalls

A firewall is a barrier to keep destructive forces away from your computer. Its primary objectives are to filter what should come in the intranet (inbound traffic) and what should come out of the intranet (outbound traffic). Only users in the intranet can access information on the server**.**

Firewalls work by using one of 2 access denial methods. The first is to allow all traffic through unless it meets certain criteria, and the second is to deny all traffic unless it meets certain criteria.

There are 3 major types of firewalls:

- **Packet filtering** - Packets (small chunks of data) are analyzed by a set of filters. Each packet is compared to a set of criteria before it is forwarded, dropped or a message is sent back to the originator. Packets that make it through the filters are sent to the requesting system and all others are discarded. This type of firewall is usually part of a router.

- **Proxy service** - Information from the Internet is retrieved by the firewall and then sent to the requesting system and vice versa. Packets are filtered at the network layer and contents of packets are evaluated at the application layer. They allow direct connection between client and host, and relies on algorithms to recognize and process application layer data instead of running application specific proxies. This type of firewall is an *application level gateway*. An application level gateway that is configured to be a web proxy will not allow any ftp, gopher, telnet or other traffic through. They offer a high level of security, but have a significant impact on network performance.

- **Stateful inspection** – the contents of each packet are not examined, but are instead compared to key parts of the packet to a database of trusted information. Information traveling from inside the firewall to the outside is monitored for specific defining characteristics, and incoming information is compared to these characteristics. If the comparison yields a reasonable match, the information is allowed through; otherwise it is discarded.

For the UBC Seeds Project, the most appropriate type of firewall is the Proxy Service. Information requested by one of the three organizations will be sent to the requesting system. By controlling traffic flowing in and out of the network, an organization is able to monitor who is requesting what and when it is being requested.

Relevant Personnel and Access Rights

Land and Building Services

Tena Vanden Berg is the *Director of Finance and Information Technology* within the Finance & Administration division of LBS. She and two other staff members within this division (internal users) oversee the functionality of the FacilityFocus software. Any security concern is handled within the application. Running through an Oracle database, it allows LBS to automate and integrate all their existing facility management, asset management and maintenance operations. Currently, there are 25 users outside the main Land and Building Services building who have access through the web version of FacilityFocus. Also there are approximately 200 users who work within Plant Operations. Authentication and accessibility limits are determined by the Director of Finance and IT.

The Service Centre team deals with problems ranging from a burnt out light to a life-threatening gas leak. They manage nine phone lines and handle over 1,750 phone calls per month. Another 600 calls per month are received via email, fax and walk-in traffic. Access to FacilityFocus is allowed in order for each operator to input order/work information. Besides recording the problem details in the Work Request Form, another important set of information includes an Account Number. For external requests, this is vital so that compensation for work is guaranteed.

The *Facility Manager* is one of the first points of contact for every Plant Operations client and is the front line for client service. Whether it's building maintenance or a new renovation, Facility Managers are empowered to prioritize all work requests and troubleshoot any problems that may arise. The Facility Manager can also be of assistance in the completion of the Work Request form. Operators within the Service Centre report to the Facility Manager for work orders that do not require immediate assistance. In regards to systems access, the Facility Manager only has rights to use FacilityFocus. He or she does not have current access to modify, update, or create data on other systems outside of LBS such as Ad Astra. Although that increases security measures and maintains each department's confidentiality of its information, inefficiencies do result. A problem involves Ad Hoc Booking for maintenance requests, which will be discussed later in more detail later.

The *Trades Person's* role within the scope of this project is the performance of the repairs as requested in the Work Request Form. This work order is updated and signed off when the repair/work is completed.

The *Foreman* is in charge of the Trades People who do the repairs. This person is next in line to look over the work order. Any sort of clarifications are adjusted and the result is sent to *Work Control*. UBC Plant Operations issues some 45,000 work orders each year for routine maintenance, repairs, preventative and predictive maintenance, as well as large and small renovation and construction projects. There is the need to plan, manage and measure the high volume of complex and time sensitive work performed by Plant Operations. Work Control overall enables the department to provide increasingly higher levels of client service by accurately prioritizing and tracking work flow of all services provided by Plant Operations.

The *Clerks* who work within Work Control complete the administrative work over the completed work order such as revisions, billing, and any reported changes during the course of repairs. All this information is updated on FacilityFocus. The original requester is also contacted for confirmation of completion.

There are no real urgencies that need to be addressed in regards to security within the scope of the use of FacilityFocus in Land and Building Services. A work order is constantly review by many internal department workers. At completion of maintenance, such a walk-thru confirms no deficiencies remain in the work, any special commissioning or training is conducted, and the project is signed-off by all parties.

Classroom Services

Classroom Services is an area of Student Services, Enrolment Services at the University of British Columbia that is responsible for scheduling academic courses, examinations, and booking all general-purpose classroom space on campus. Outdoor bookings requests for the campus are also handled except for the Athletic Fields, Robson Square, and the upper level of the Student Union Building.

Among the people who can make bookings include students, faculty, and staff. Faculty and staff can make bookings for official functions associated with the university. For un-official functions, a specific faculty or staff person must take on the responsibility of sponsoring the event, and must seek appropriate approval. Any cancellations must be notified to Classroom Services.

The structure of Classroom Services:

Justin Marples, Director
Kelly Simmons, Manager
Lois Bishop, Scheduling Coordinator
Patti Kraigher, Exams Scheduling Clerk
Brigitte Priebe, Course Scheduling Clerk
Christine Williams, Secretary/Scheduling Clerk

The department uses Ad Astra for scheduling. This software package serves 250 university users through the Web. For instance, Faculty can log in and go to the scheduling option where information such as courses, sections, time, and place will be given. Users will create the sections and allocate the space. Advanced security features enable multiple users to schedule, book resources, bill, and view without overstepping their bounds. Among the data that is read from this system include - room capacity, square footage, information for classes (how many students), efficiency of space utilization. In addition, Classroom Services also have to keep up to date with new features within all rooms and deal with renovations and capacity changes. However, due to Ad Astra's limited reporting capabilities, Land & Building Services – Plant Operations probably have the most reliable data since they are the ones who do the actual maintenance work.

Access to course sections and rooms is restricted to Departments and Rooms that the user's login privileges allow. Faculty and other users can request and schedule events and query for available rooms. Requests are then forwarded automatically to the appropriate scheduler for approval.

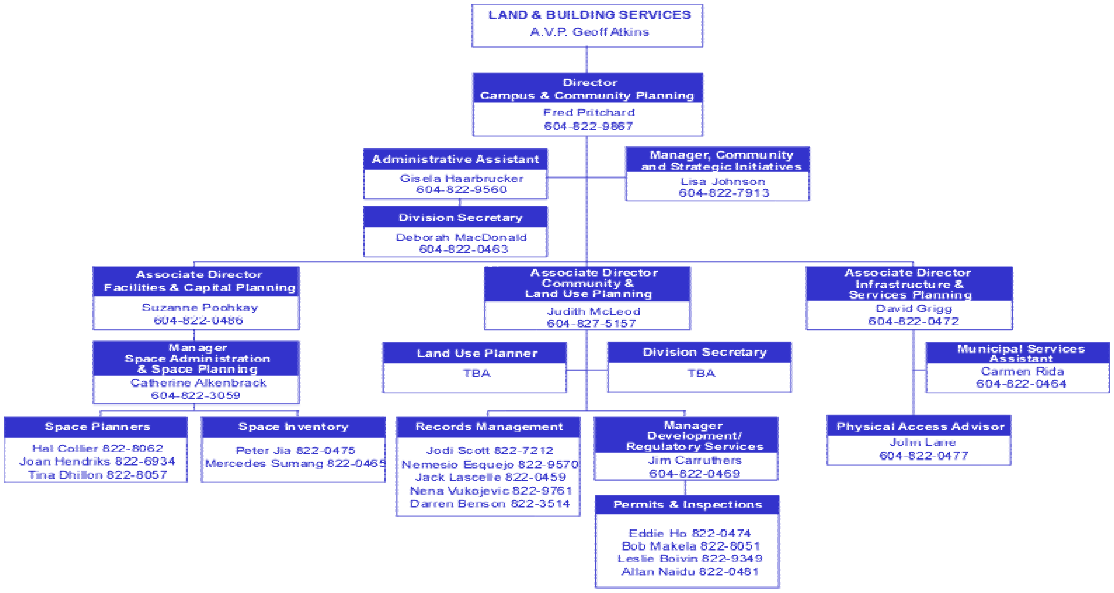
Campus & Community Planning

The Space Analysis Unit maintains and monitors the entire inventory of space at UBC.

The unit performs statistical analysis related to space, provides data and reports to all academic and administrative departments within UBC, outside consultants and the Ministry of Advanced Education, Training and Technology.

Space information and individual reports based on specific requests for space are prepared by the Space Unit in addition to annual major reports for the Ministry of Advanced Education, Training and Technology. One of these reports is the Annual Facilities Inventory Report, which summarizes UBC's space inventory compared with its entitlement. This report serves as a reference for UBC's major capital funding from the Ministry. A second report prepared by the Unit provides information arising out of calculations based on the Wall Formula, which calculates the proportion of minor capital funding among the major B.C. Universities and results in determination of the province's funding allocation for UBC. The space unit serves as a resource for space information and as a support role in space planning.

The Structure of C&CP:



Peter Jia, who is a *Senior Analyst* within this department keeps track of building function and usage only for the whole UBC campus. Campus and Community Planning controls the space database and access. This department holds campus wide space and facility information. Simply

put, the space inventory unit in Campus and Community Planning department is the "accountants of space" by keeping records of who is using what on campus. The UBC Space Inventory Database (SID) was originally designed using a software program called D-Base. However, the database has since been transformed into a relational database using Microsoft Access.

The database is located in a server, and users can access information on a read only basis from a remote PC. Read only access users of the database on the server are given different security levels, which are set by the Senior Analyst. Land and Building Services and Classroom Services do not have access to this database. Instead they must contact the Campus and Community Planning Administrator to retrieve information, or to request any changes or updates to data. Each faculty has their own contact person and a backup is made onto the UBC server every night. As a result, Peter Jia and his team of analysts like to be notified of changes in the room by the people who use the rooms constantly.

PART IV: Implementation

Project Plan

Project plans are a great tool to guide any organizations during the implementation process. Indeed, project plans may act as a "road map" for organizations, and serve as a great managerial device. Although the following is only a recommended plan, it should be pointed out that there are some crucial concerns which must be addressed by each respective division, regardless of the specific project plan preferences that they may each adapt. Specifically, these departments must conduct internal as well as cross-departmental discussions on who should implement the recommended resolutions. Included within these discussions, resource factors such as the require number of people and the total estimated time necessary for the entire implementation process must be considered. In addition, factors such as estimation on both internal costs within each department (i.e. providing training for staff personnel) and external costs (i.e. purchase of appropriate middleware) should also be carefully researched. Clearly, even with all factors taken into account, the three departments may nevertheless encounter some problems or even disagree on some specific topics. It is essential therefore, for all three departments to ensure an excellent communication channel between them during the entire implementation process.

Project Timeline

I. Decision Making Process

Recommended time frame: 1 month

Tasks	Duration	Departments
Final presentation conducted by UBC student consultants	**Dec 3**	All departments are encouraged to attend
Internal discussions of the possible resolutions as suggested by UBC students within each respective department	**Dec 3 - 5**	CS, C&CP, LBS
Final stages of internal meetings for feedback discussions and determining problem resolutions	**Dec 5 - 9**	CS, C&CP, LBS
****Internal discussion within each respective department on who should implement the resolutions (resource factors such as the amount of people and time needed must be considered)**	**Dec 9 - 16**	CS, C&CP, LBS

Cross departmental meetings between all 3 divisions to discuss each other's needs and concerns	**Dec 16 - 18**	All departments
****Cross departmental discussion between departments on who should implement the resolutions (resource factors such as the amount of people and time needed must be considered)**	**Dec 18 - 26**	All departments
Arriving consensus for final decision process	**Dec 26 - Jan 3**	All departments

II. Purchasing Process

Recommended time frame: 1 month

Tasks	Duration	Departments
****Internal cost estimation of the selected problem resolutions (i.e. cost of training staff personnel)**	**Jan 3 -10**	CS, C&CP, LBS
Ad Astra account created for LBS to schedule maintenance	**Jan 5**	CS, LBS
Final stages of internal meeting for feedback discussions	**Jan 10 -12**	CS, C&CP, LBS
LBS clerks trained to use Ad Astra for scheduling	**Jan 6**	CS, LBS
General cross departmental meetings for final concerns	**Jan 13**	All departments
****External cost estimation (i.e. purchase of Middleware)**	**Jan 13 - 18**	C&CP
General cross departmental meetings for feedback & Concerns	**Jan 18 - 20**	All departments
Formation of cost proposals and final modifications	**Jan 20 - 24**	C&CP
Submission of cost proposals and waiting for budgetary approval	**Jan 24 - 31**	C&CP
Final cross departmental meetings for general concerns	**Feb 1**	All departments
Contacting selected vendors for purchase	**Feb 1 - 3**	All departments

III. Implementation Process

Recommended time frame: 2 month

Tasks	Duration	Departments
Implementation of selected resolutions (i.e. middleware)	**Feb 3 – Mar 14**	All departments
Internal training process within each departments	**Mar 10 – 14**	CS, C&CP, LBS

User feedback within each departments	**Mar 14 – 21**	CS, C&CP, LBS
General cross departmental meeting for possible concerns and feedback	**Mar 21 – 28**	All departments
Testing period and possible further training	**Mar 28 - Apr 4**	All departments

Conclusion

The UBC SEEDS Database Interface Project is a project attempting to improve the quality of and access to information from the three major UBC organizations. The departments are Classroom Services, Land & Building Services, and Campus & Community Planning.

The business processes are identified and mapped into diagrams to show the flow of how the University operates as well as how organizations interact with one another. The three organizations that we focused on for this project were Land and Building Services, Classroom Services and Campus and Community Planning. The procedure for requesting maintenance was our area of concern, in terms of time required for the entire process to be completed.

To reduce the waiting time for booking a classroom for maintenance and servicing at present, we have proposed that Land and Building Services be given access to Ad Astra where they can make bookings directly from their department. This proposed solution poses no extra costs, since no new software needs to be purchased.

Throughout the project, we identified that another major area of concern is to maintain data consistency. For the report generation process, it is detrimental that the data contained in each organization's database is consistent with the others. We identified two solutions to solve the problem; the first is to link all three organizations so that one department's database will include all the data that everyone requires, and the second is to use middleware. Several flaws were identified with modifying the database, such as time and cost inefficiency since all three departments are far into their implementation phases. Thus, we have chosen the option of using a middleware. Middleware will solve data inconsistency problems by allowing interactions between the three databases. An update in one database will propagate changes to related information in another. Middleware does not require modifications that would interfere with the databases as they are now.

The requirements for middleware were identified and several companies that specialized in middleware were focused on. Based on costs and relevant function matches between what the company offers and UBC's needs, Data Junction was the company chosen.

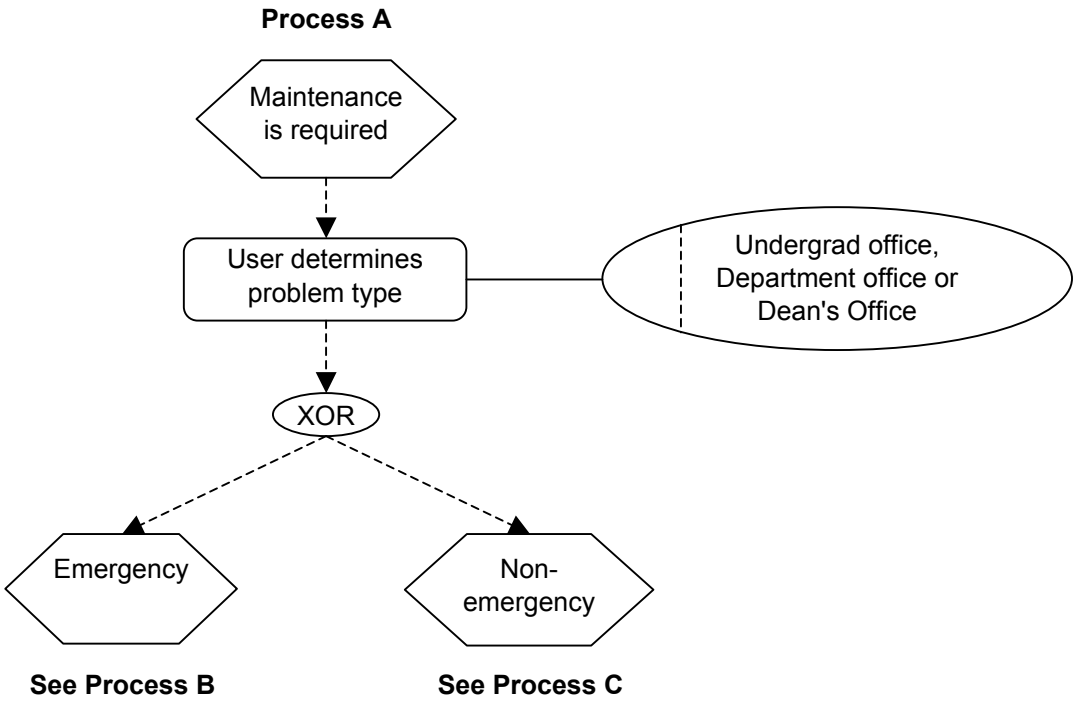
This new system will ensure accurate and timely information. Correct and up-to-date information will help to improve organizational planning and faster decision making. Report generation will be easier and quicker due to data consistency.

After a cost-benefit analysis, costs for implementing the new system was estimated at $15,000 USD. The cost includes a single-threaded system, as well as training costs. Opportunity costs of the time that UBC's IT staff must spend on the implementation of the software must be taken into consideration.

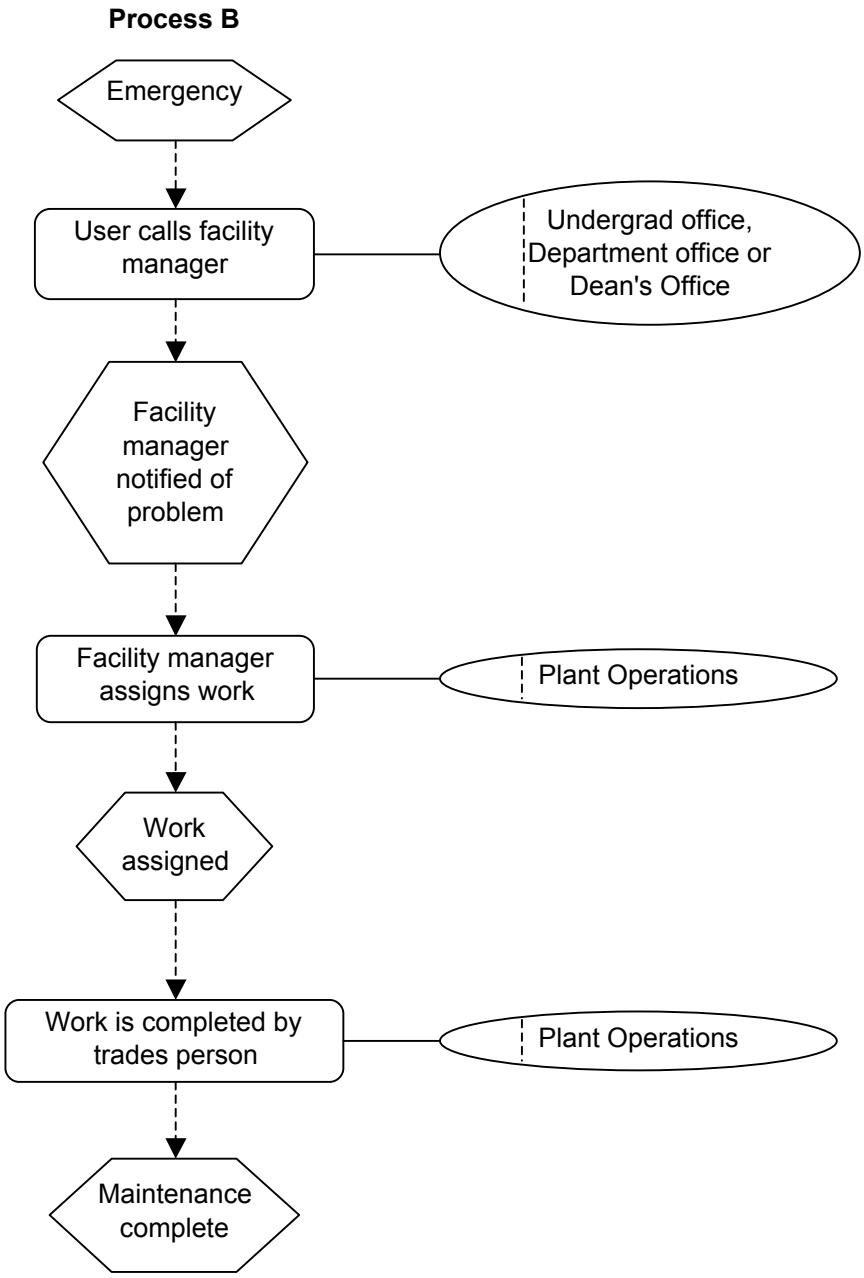
Furthermore, the possibility of acquiring a firewall was also considered. The firewall type chosen was a proxy server, where data inflow and outflow can be monitored and controlled, as well as preventing any unauthorized external access to the databases. The firewall will also protect against any viruses or bugs that could pose potential harm to the system.

The UBC SEEDS Database Interface Project has given all three groups involved an extensive learning experience. Each group became familiarized with the process of the three major organizations running the campus, which acts as the backbone to the University. Research has been completed to suggest new methods to manage the databases that would increase efficiency and make business processes easier. We would like to thank the three organizations for providing us with their time and the information necessary to formulate our report.

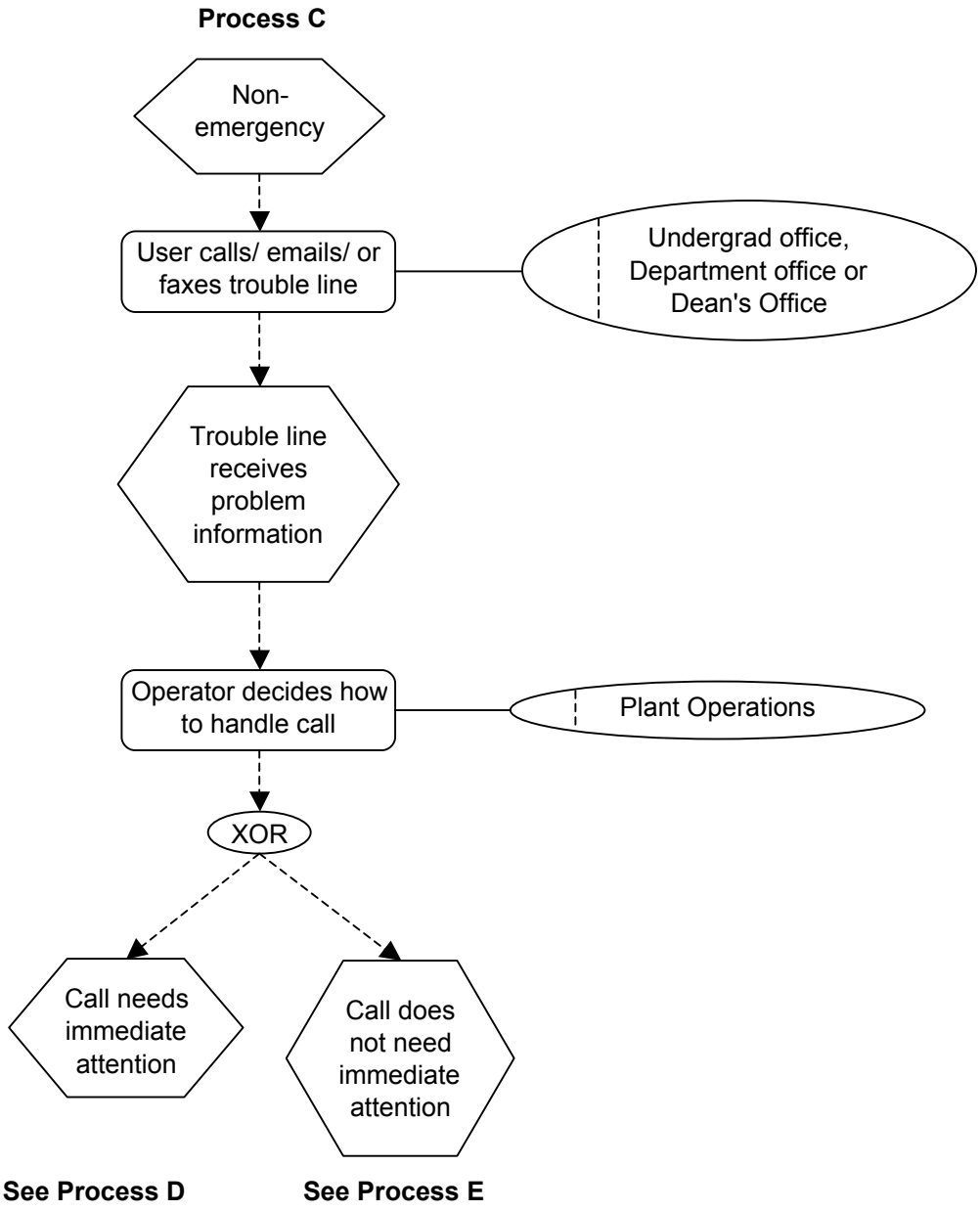
Appendix A: Maintenance Request Process



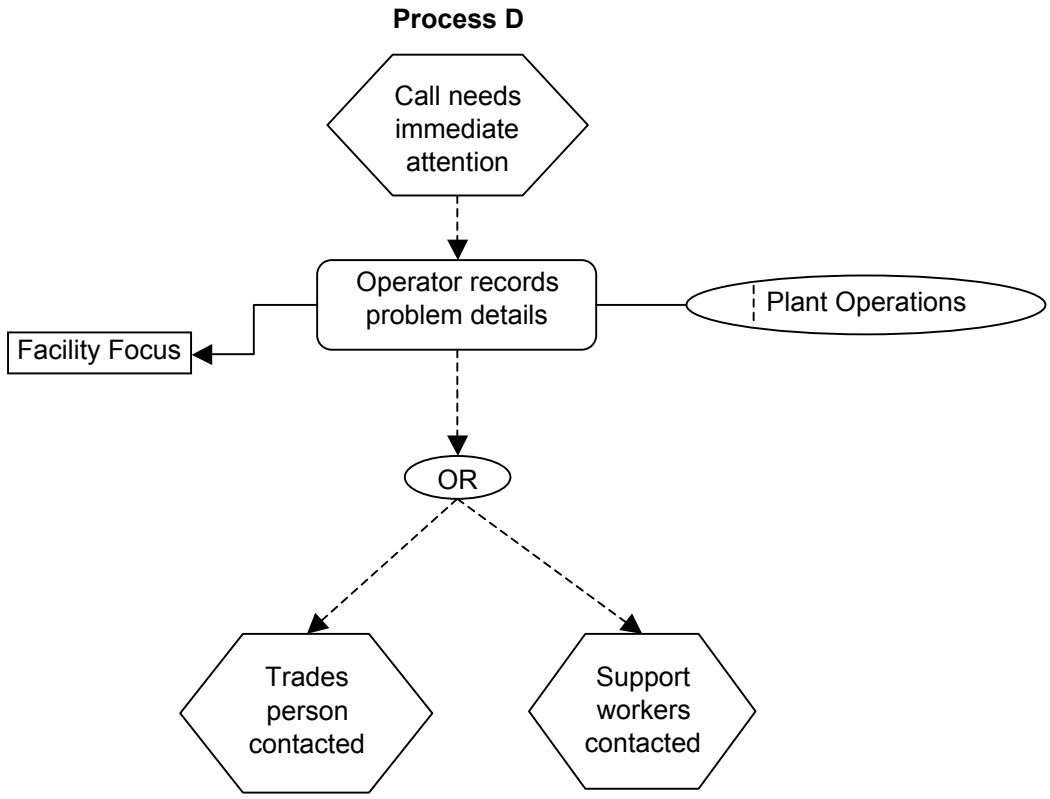
Appendix A: Maintenance Request Process



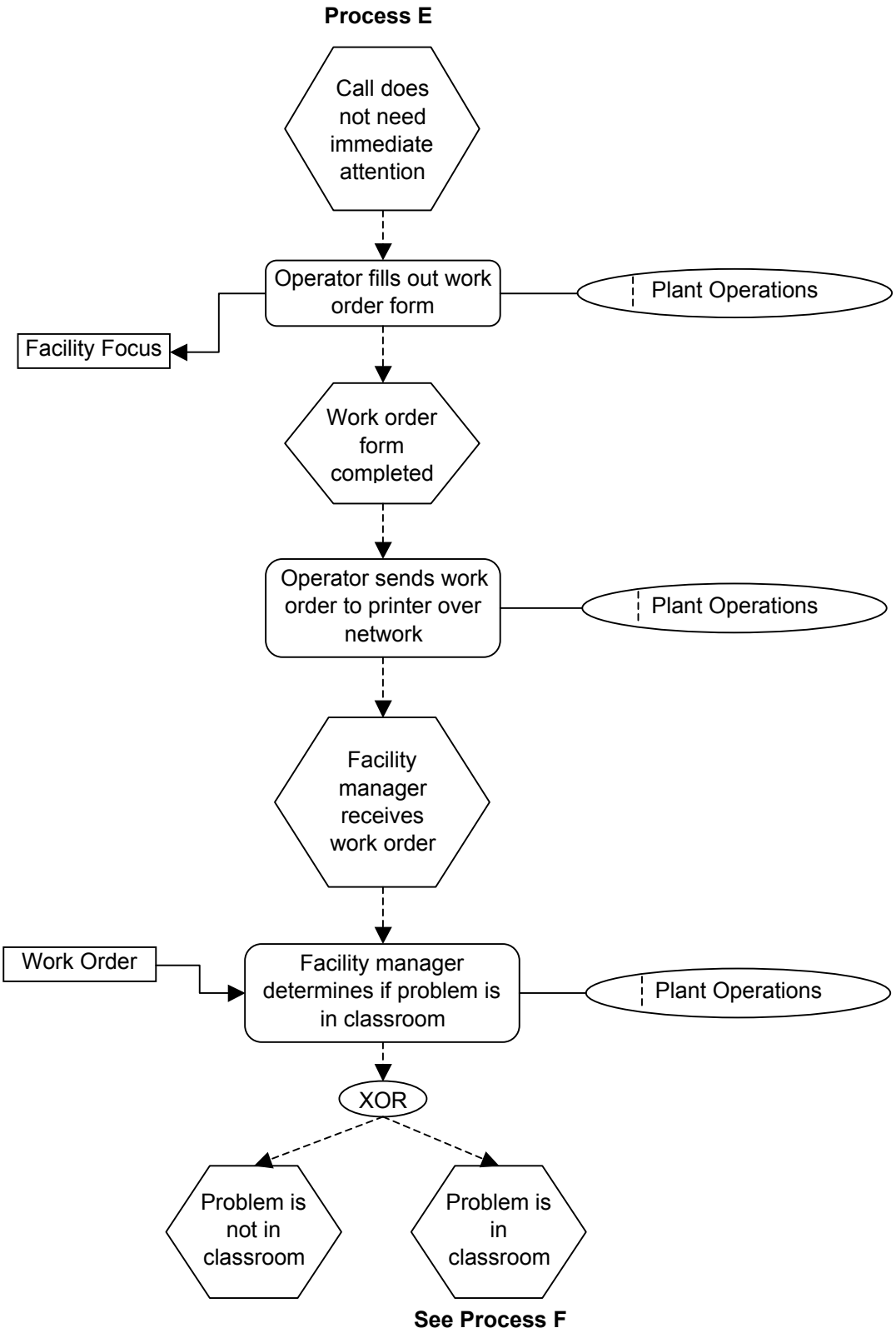
Appendix A: Maintenance Request Process



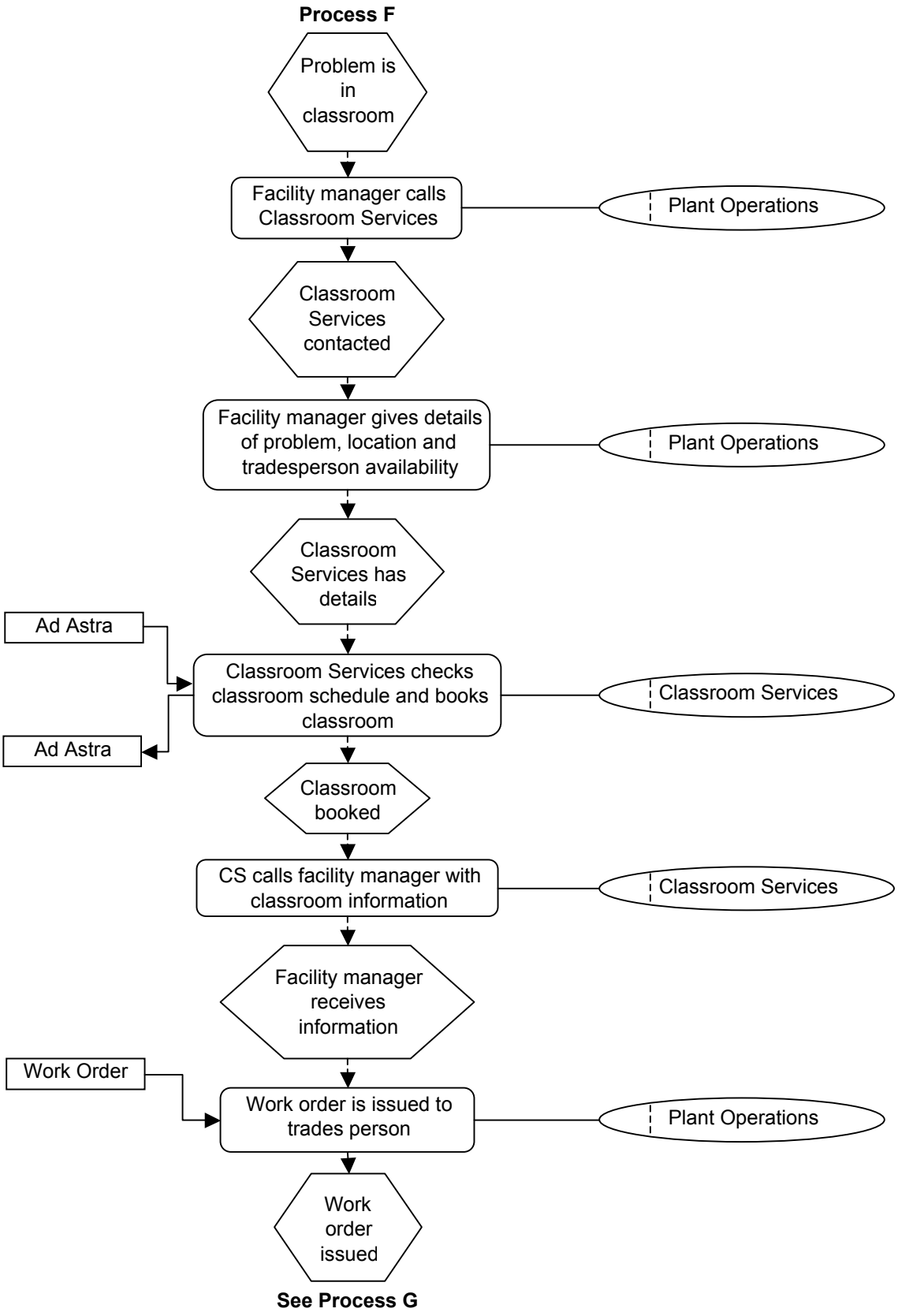
Appendix A: Maintenance Request Process



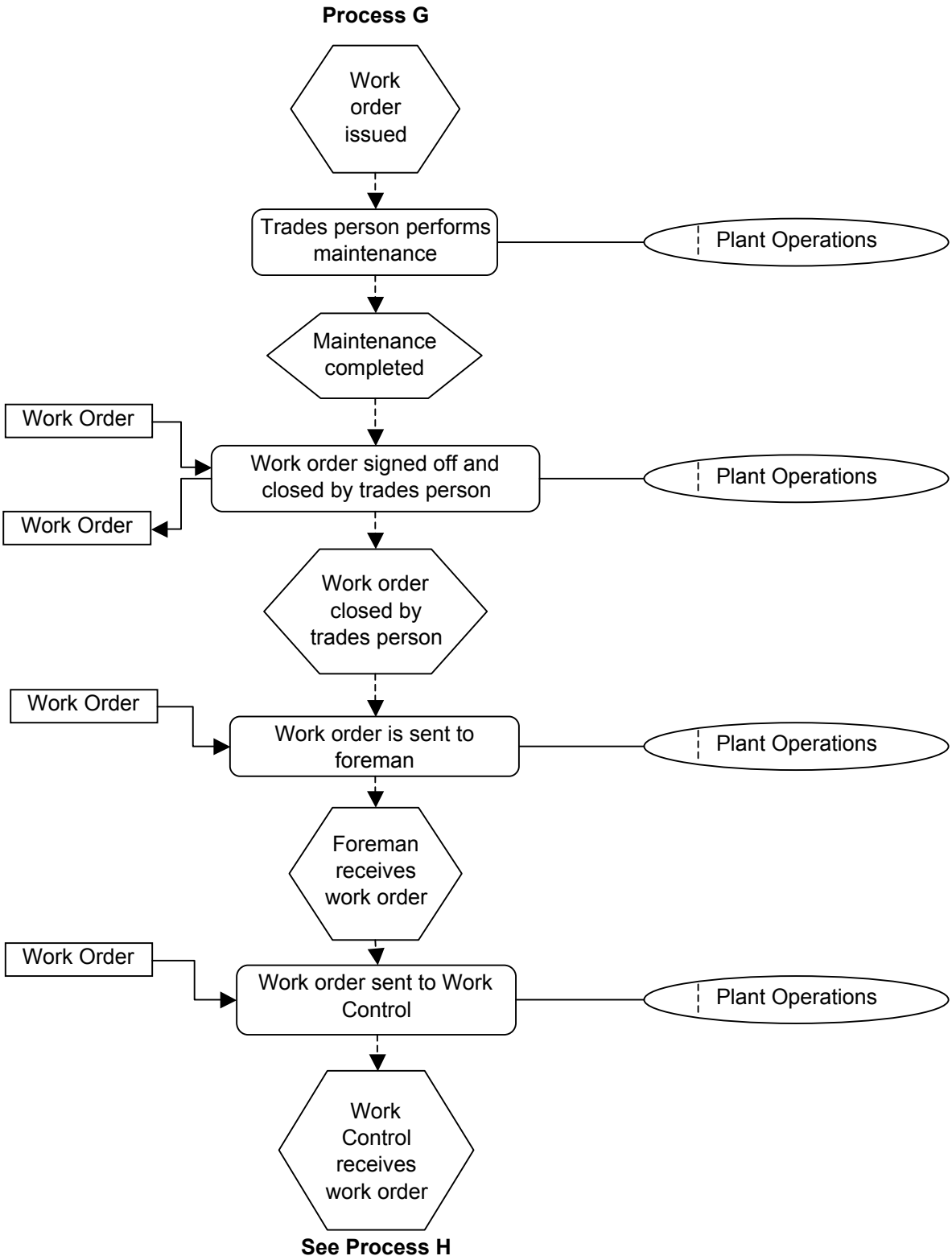
Appendix A: Maintenance Request Process



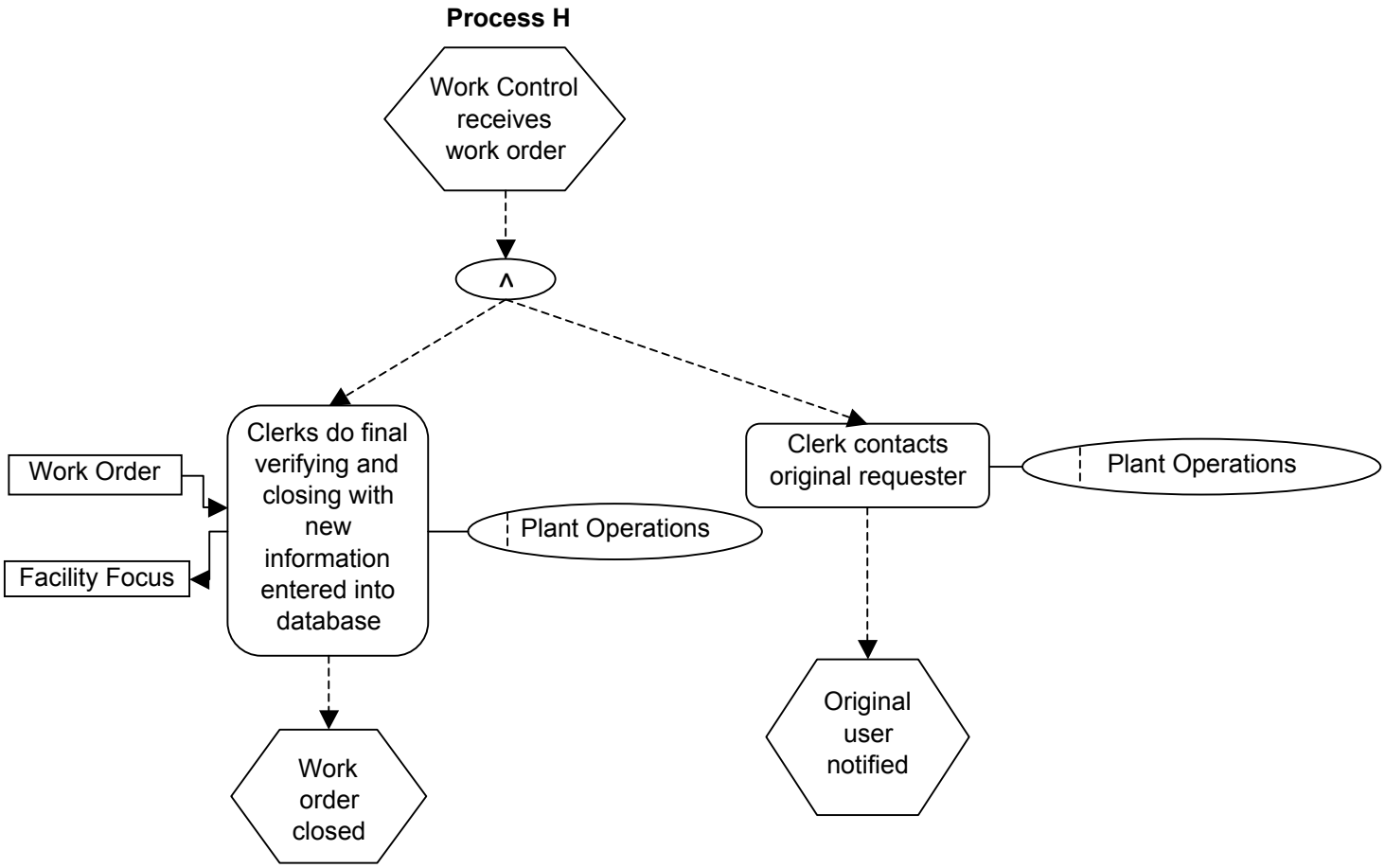
Appendix A: Maintenance Request Process



Appendix A: Maintenance Request Process



Appendix A: Maintenance Request Process



Appendix B: Revised Maintenance Request Process