

# Let's Recycle!



Designing the Inbound Logistics of Catalysis

**University of Twente**

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# Bachelor Thesis



catalysis<sup>AG</sup>



**Universiteit Twente**  
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## Management Summary

### Fondel Development and Catalysis

This Bachelor Research project is conducted at Fondel Development in Rotterdam. Fondel Development focuses on investment opportunities in the field of both primary and secondary metal winning on a global scale. One of the projects of Fondel Development is Catalysis. Catalysis is a joint venture of Fondel Development and Catalysis-AG. Catalysis is a recycle company that is going to recycle catalyst waste from refineries in the petrochemical industry. The processing plant of Catalysis is under construction and is therefore currently not yet operational.

### Goal of the Research

This research was conducted to achieve the following goals:

- To get insight in the current rules and regulations that apply to shipments of waste within or into the EU,
- To design processes for the inbound logistics at Catalysis,
- To get insight in the most important benefits and critical success factors for IT projects at Fondel Development.

### Rules and Regulations

To transport waste within or into the European Union permission has to be made requested. The necessary procedures are described in the EC1013/2006 regulation. The catalyst waste that is recycled by Catalysis falls under the most stringent procedures because of its hazardous characteristics. This means that a shipment of waste has to be approved by the authorities from the following countries:

- Dispatch; the country from which the shipment is sent,
- Destination; the country which receives the shipment,
- Transit; the countries where the shipment goes through.

### Design of Processes for Inbound Logistics

The inbound logistics consider the process from acquiring the catalyst waste from the waste producer until the waste is received at the recycling plant at Catalysis, Halle, Germany. Catalysis wants to use the process designs:

- to instruct future personnel,
- to create the necessary trust with waste producers,
- to improve transparency towards local environmental authorities,
- to apply for permits with the local authorities,
- to apply for an ISO 9001:2000 certification,
- to increase the control and efficiency of the process.

The different processes are designed using flowcharts.

**Critical Success Factors for IT Projects**

Effective use of IT allows Fondel Development to optimize the planning of production, purchase of spent catalysts and the sales of finished products. However, Fondel Development has no experience in the management of IT projects. They therefore need to know the most relevant critical success factors for IT projects in their organization.

The most important critical success factors for Fondel Development are;

- Top Management Support
- Timing and Planning
- End User Involvement
- Effective Communication
- The Centralization of IS Management

## Preface

To earn my Bachelor's degree in 'Industrial Engineering and Management' at the university of Twente, I had to conduct a research project of 10 weeks. This research can be conducted at the University or in an (commercial) organization. Because of my rather long career at University of Twente I was very much hungry to put all the theory from my courses to the test by applying it in a 'real world environment'.

Based on my passion with applied technology I choose to do an internship in an organization which is constantly searching for new (applications of) technologies; Fondel Development. I can surely say that this was a very good decision. I enjoyed working in this very small, dynamic organization which is full of different cultures, management styles and above all humor. My time at Fondel Development would definitely not have been the same without;

Jelle and Jaap, the managing directors of Fondel Development, who made me feel very much 'part of the team'. The dedication and entrepreneurship shown by both of you can be a real source of inspiration.

My colleagues Pjotr, Judytha and Bernard. Thank you for all the interesting conversations about the cultural differences and similarities of Poland and Holland, all the help with my work, the very useful pointers for bars in Krakow and most of all, all fun we had.

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The members of my thesis committee from the university; Christiaan Katsma and Peter Schuur for all the feedback, good advice and flexibility.

All my friends, who are always available to provide me with some very welcome distraction from time to time.

My parents, who are always there for me for a word of advice, or just to talk to.

Iris, all your trust, inspiration, patience, energy and love cannot be expressed in words.

Michiel Bax, Utrecht, 2009.





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# 1 Introduction Organizations

In this chapter the organizations that are involved in this research will be introduced. These organizations are: Fondel Development (§ 1.1), Fondel Commodities (§ 1.2) and Catalysis-AG (§ 1.3). How the different involved organizations collaborate for the project at Catalysis will be explained in § 1.4.

## 1.1 Fondel Development

Fondel Development B.V. (FD) is a business development company belonging to the Fondel Group (international metal trading, processing and recycling company in metals and alloys for the stainless steel industry). FD focuses on investment opportunities in the field of both primary and secondary metal winning on a global scale. Subsequently, with the financial support of the Group, the in-house expertise in project management and knowledge of the metal cycle processes, they turn those opportunities into a sustainable business. Through their international network they enable win - win cooperation between innovative technology holders and (secondary) material streams holders. They aim for a healthy portfolio of assets with varying degrees of technological, financial or business risk. FD is a young, growing organization and was founded about two years ago.

Currently there are in total six people working for FD; two directors, two senior project engineers and two junior project engineers. An organizational chart of FD is presented in figure 1.

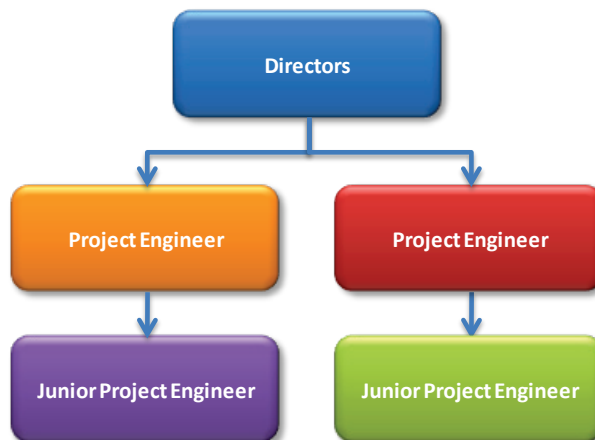


Figure 1: Organizational chart Fondel Development

At Fondel Development multiple projects are running throughout the year. Next to the project at Catalysis which will be discussed in this report, there are projects for a new battery recycling plant in Poland, a recycling plant for pickling solutions used in the cleaning baths for the finishing of stainless steel products, and the development of a mobile waste recycle plant for slag streams of waste incinerator companies and more.

## 1.2 Fondel Commodities

As mentioned earlier, FD is part of the Fondel Commodities group. A total of 10 companies operate under the wing of Fondel Commodities making it a well established name in the industry. In total the different organizations that belong to the Fondel Commodities group employ about 400 people and together have a turnover of € 1.5 billion annually. Besides FD, three other main organizations operate under the wing of the Fondel Commodities group. A brief introduction the other main organizations within Fondel Commodities will be given next, an organizational chart of the Fondel Commodities group is presented in figure 2.

Fondel Metals; a supplier of Ferroalloys and Nickel to the stainless steel, low-alloy steel, foundry and chemical companies of the world. Geographically, Fondel Metals is most active in Europe, Russia, India, the Middle East and South America.

Fondel Chemicals; focuses on the consumption of chemicals by the metal producing industries and mining companies. Other markets include the production of metal salts, raw materials for the production animal feed as well as the production of pigments for the colouring industry.

Fondel International; a holding company, the subsidiaries of which focus on the production and sale of primary raw materials in the form of metals, Ferroalloys and powders to the following industries:

- Stainless Steel
- Low-alloy steel
- Agriculture
- Aluminium, and
- Mining

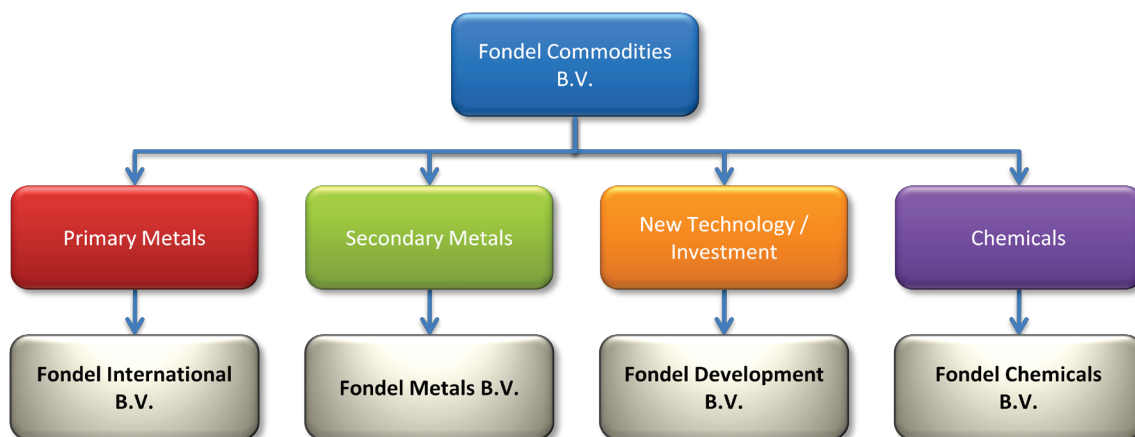


Figure 2: The Fondel Commodities Group

### 1.3 Catalysis-AG

One of the current projects at FD is the construction of a new recycling plant in Helbra, Germany. In this plant catalyst waste from the petrochemical industry is going to be recycled using a new recycling process. This process is much more energy efficient using about 80 percent less energy than other processes used today. The plant is being developed and constructed in a joint venture with Catalysis-AG who has extensive experience with plant design and constructing. The Fondel Participations is providing financial support and FD is providing project management expertise for the project.

Catalysis is going to recycle catalyst waste from amongst other, petrochemical refineries. The catalyst waste consists of balls (0.5 till 6mm in width) and cylinders (width 1.6-3.2mm and length 4.1-6.1mm). The catalyst waste is saturated and therefore needs to be replaced. The waste is contaminated with metals and other chemicals. These metals are highly environmental unfriendly and dangerous for the public health because they cause cancer. Next to these dangers the mixture is also pyroforic; the mixture will self self-ignite when exposed to air. Because of the high risk involved in the transport and handling of the materials, an extensive set of rules and regulations is in place.

The plant will become operational in 2009. Fondel Metals will then use its trading expertise and logistical network to support inbound and outbound logistics for Catalysis. The traders with Fondel Metals and Catalysis-AG will ensure availability of catalyst waste. Fondel Metals has the solitary right to buy and trade in all finished products from Catalysis.

### 1.4 Fondel and Catalysis

For the project at Catalysis-AG a joint venture with FD has been formed. The investment in the project is not supplied by FD, the Fondel Commodities Group has a separate investment company. This company is called Fondel Participations and concentrates on long term investments in the metal industry. As was mentioned before, Fondel Metals will have the solitary right to buy all finished products of Catalysis. The structure of the different organizations for this project is presented in figure 3.

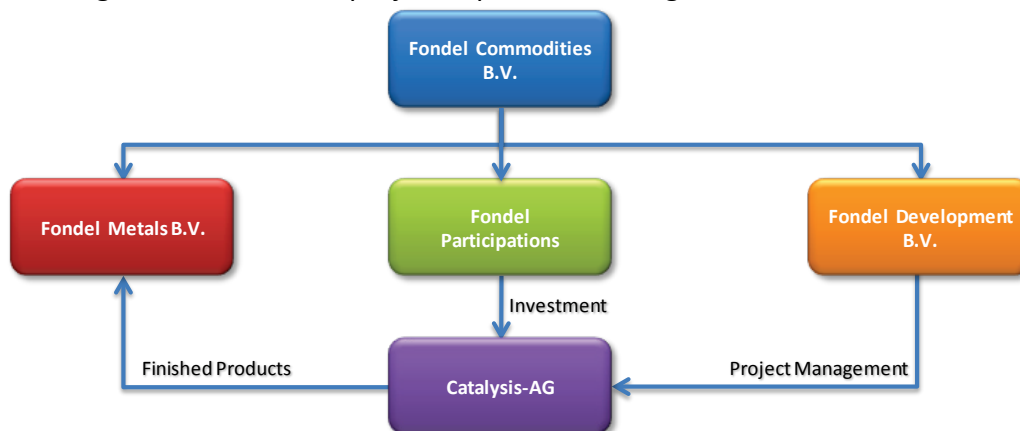


Figure 3: Catalysis Project Structure





## 2 Introduction Research Project

In this chapter the research project will be introduced. The scope of the research is defined (§ 2.1), resulting in a number of objectives for this research (§ 2.2). To achieve the objectives certain outcomes have to be realized (§ 2.3). This process will be constructed around a number of research questions that will be introduced in § 2.4. The research cycle that is used is introduced in § 2.6.

### 2.1 Defining Problem Statement

Currently the recycling plant of Catalysis is under construction. The basic metal structure for the building is complete and construction of the systems that will perform the actual recycling process can commence shortly. This new recycling plant is FD's first project to arrive at the actual construction phase, FD is therefore confronted with a lot of new challenges.

In order for the plant to become operational, supporting processes for the main recycling process have to be in place. Inbound and outbound logistics are needed for the shipments of waste materials and transportation of the finished products to the customer. Also traders with Fondel Metals and a trader within Catalysis will have to work together to ensure availability of waste materials for recycling. Fondel Metals will handle sales of finished products on its own.

All operational processes at Catalysis comprise the activities that are required to support the shipment of wastes from the suppliers location, until the finished products from Catalysis are delivered to the customer.

These processes are divided into three parts; inbound logistics, the recycling process and outbound logistics. Catalysis is managing plant construction and development of the recycling process. Within the scope of FD are the inbound and outbound logistics and the trading of waste and finished products. Currently, FD has little understanding of how to design these processes.

This BA research will focus on the inbound logistics and the trade of waste materials. Based on the discussion above the following problem statement is formulated for this research;

#### **Problem Statement**

*Clearly defined business processes for the inbound logistics at Catalysis are required before the Catalysis plant can become operational.*

## **2.2 Research Objectives**

The waste (spent catalysts) that is recycled by Catalysis is very hazardous. Catalysis therefore has to deal with a large set of rules and regulations enforced by the EU on the transport of waste. Providing insight in the current regulations and their consequences for the operations at Catalysis is essential. Currently, the insight that Catalysis has in these regulations is out-of-date, updating these insights is therefore a primary objective of this research.

Standard processes for the inbound logistics at the Catalysis plant will have to be designed. Currently very limited insight in these processes is available and a lot of the processes have not been designed yet. For the documents that are going to be used in these processes, templates will have to be developed. The designed processes and templates will have to be used by future personnel. Therefore, a manual will be created.

As described in §1.1, FD is currently working on different projects. All these projects are new business ventures in the recycling industry. Just like the Catalysis project, the products from the different ventures are going to be sold using the network of Fondel Commodities. To do so, support of IT systems is required. FD wants to know what the potential advantages of IT support are and how they should manage the development and implementation of the different IT systems that are needed.

To summarize, the objectives are;

- Providing understanding in the current rules and regulations that apply to the transport of waste in the EU
- Design standard processes for the inbound logistics at Catalysis
- Develop templates for the documents that are used in the designed processes
- Present the processes and documents in a manual that is going to be used by future personnel
- Identify and discuss the most important CSFs for IT projects at Fondel

## **2.3 Expected Outcomes**

To be able to successfully achieve the described objectives a number of outcomes have to be achieved.

- Designs of the processes for the inbound logistics at Catalysis
- Process descriptions for the different rules and regulations that need to be taken into account for the transport of waste
- Standard templates of the necessary documents for the different processes at Catalysis
- A manual for the inbound logistics at Catalysis presenting all process descriptions, clarifications and templates
- Recommendations on the management and execution of IT projects in the Fondel Group

## 2.4 Research Questions

In the light of the formulated objectives and expected outcomes, the following two main research questions have been formulated:

*“What is the appropriate arrangement for the inbound logistics of Catalysis, considering the various relevant rules and regulations in the EU?”*

*“What are the benefits for Fondel Development from supporting business processes with IT and how can Fondel Development achieve these benefits?”*

To structure the analysis, discussion and report, these questions are divided into three parts. For each of these parts the following sub research questions have been formulated:

1. *Complying to the rules and regulations for the transboundary shipments of waste in the European Union*

- 1.1 *Which rules and regulations apply to the processes of inbound logistics at Catalysis?*
- 1.2 *What procedures are dictated by these rules and regulations?*
- 1.3 *What is the recommended role of Catalysis in these procedures?*

2. *Designing the business processes for the inbound logistics at Catalysis*

- 2.1 *What design method has to be used for the design of process descriptions?*
- 2.2 *What are the different processes that are required for the inbound logistics?*

3. *Benefits of IT and managing IT projects*

- 3.1 *What are the IT related needs of Fondel Development?*
- 3.2 *What are the benefits of supporting business processes with IT?*
- 3.3 *What are important critical success factors for IT projects within Fondel?*

## 2.5 Research Method

This research is mainly based on qualitative information. To be able to formulate conclusions that result practical outcomes for the real situation, a critical view towards information sources is vital. For this research different information sources have been used; different key persons have been interviewed and regulations from the European Union have been analysed. Also insights and models from scientific literature have been applied. The results from the literature review are summarized in chapter 3. To create insight in the different regulations for the transport of waste materials the relevant regulations have been summarized in chapter 5. The way data has been collected and reviewed for the design of the business processes is described in § 6.2.



### 3 Theoretical Framework

To effectively answer the research questions, existing scientific theory is used. Making use of existing theoretical models saves time and improves quality of the analysis. The most important concepts are introduced in this chapter. All concepts discussed in this chapter are applied throughout the report. This chapter acts as a knowledge base and is somewhat separated from research process which is discussed in the other chapters of this report.

#### 3.1 *Business Process Redesign Methodology*

The process that is undertaken in this project is comparable to a business process reengineering (BPR) cycle (Kettinger, Teng, & Guha, 1997; Stoica, Chawat, & shin, 2004). Many methodologies have been designed for BPR, Kettinger (1997) has compared different methodologies, techniques and tools and Stoica (2004) followed with an update for the methodologies. Based on their conclusions and recommendations the method of Davenport (1990) is selected. The methodology consists out of five basic steps:

1. Develop a business vision and process objectives
2. Identify the processes to be redesigned
3. Understand and measure the existing processes
4. Identify IT levers: awareness of IT capabilities can and should influence process design
5. Design and build a prototype of the new process

Important is the way IT is incorporated in this methodology, the capabilities of IT directly influence the process design, and therefore its performance.

#### 3.2 *IT as Enabler*

When applying BPR, change is promoted and new processes and styles of working will be introduced. Certain preconditions are required to make change possible. These preconditions are known as enablers and may be defined as elements that act as vehicles for processes to change. IT promotes changes in organizations, mainly changes in the nature of the work, the integration of business functions, and the transformation of competitive forces (Davenport & Short, 1990).

Oz lists a number of benefits that can generally be linked to the implementation of an information system (IS) that enables electronic data interchange (EDI) (Oz., 2004):

- Cost savings
- Speed
  - o Real time information
- Accuracy
- Security
- System integration
- Just-in-time support

### 3.3 IS Management

In an organization with multiple locations a decision has to be made whether the information systems are going to be managed by one central IT department or the management of systems is distributed throughout the organization. To make a decision between these two approaches it is important to list the benefits of the two alternatives and evaluate the importance of the different benefits for the organization at hand. The benefits of the different approaches as listed by Oz (2004) are summarized in table 1.

Centralized IS Management	Decentralized IS Management
Standardized Hardware and Software	Better Fit of Systems to Needs
Easier Training	Timely Response
Common Reporting Systems	Applications Development by End Users
Effective Planning of Shared Systems	Innovative Information Systems
Easier Strategic Planning	
Efficient use of IS personnel	
Tighter Top Management Control	

**Table 1: Benefits of centralized and decentralized IS management (Oz, 2004)**

### 3.4 CSFs for ERP Success

Bax and van der Drift have identified the most important CSFs for ERP projects in small and medium enterprises in 17 leading scientific publications (Drift & Bax, 2008). These CSFs are presented in table 2. A more in depth discussion about these CSFs is presented in chapter 7.

Important CSFs
Top Management Support and Commitment
Change Management and Cultural Readiness
Business Process Change (BPC) - Synergy of Business and IT
Training of End-Users
Strategic Implementation Plan and Vision (Timing)
Monitoring and Evaluation of Performance
Excellent Project Management and Team (leadership)
Effective Communication

**Table 2: Important CSFs from literature (Drift & Bax, 2008)**

### 3.5 *Organizational Theory and Information Management*

#### 3.5.1 Vertical Linkages

In a production company where the need for efficiency is greater than the need for learning, vertical linkages for information sharing are important (Daft, 2001). The vertical structure has the following properties:

- Specialized tasks
- Strict hierarchy, many rules
- Vertical communication and reporting systems
- Few teams, task forces or integrators
- Centralized decision making

The need for vertical information systems is present, these information systems supply periodic reports, written information and computer based communication distributed by the managers. These information systems make the communications up and down the hierarchy more efficient (Daft, 2001).

#### 3.5.2 Functional Structure

According to Daft, the functional structure results in consolidated knowledge and skills of the different persons in the organization. This provides a valuable depth of knowledge in the organization. The functional structure is most suited when in-depth expertise is critical to meeting organizational goals. And when the organization needs to be controlled through the vertical hierarchy and efficiency is important. The strengths and weaknesses of the functional structure as mentioned by Daft are summarized in table 3. (Daft, 2001):

Strengths	Weaknesses
Allows economies of scale	Slow response time to environmental changes
Enables in-depth knowledge and skill development	Involves restricted view of organizational goals
Enables organization to accomplish functional goals	Poor horizontal coordination among departments
Is best with one or few products	Results in less innovation
	May cause decisions to pile on top

**Table 3: the strengths and weaknesses of the functional structure (Daft, 2001)**

#### 3.5.3 Mediation and Collaboration

Teng et. al. stress the importance of the incorporation of IT in business processes. According to them, business processes can be classified according to two dimensions; mediation and collaboration (Teng, Grover, & K.D.Fiedler, 1994).

The degree of mediation refers to the sequential flow of input and output among the participants functions in a business process. A process at a high degree of mediation involves a large number of intermediate steps, performed in various functions that contribute indirectly to the process's outcome.

The degree of collaboration is related to the degree of collaboration between functions through information exchange. The frequency and intensity of information exchange can range from none (process at the low degree of collaboration) to extensive (process at the high degree of collaboration).

Companies have to try to reduce the degree of mediation and increase the degree of collaboration in their business processes. This increases flexibility and allows to develop products that better satisfy the needs of the customer. The use of IT can reduce the degree of mediation by making use of shared databases, allowing people to work together on documents and graphics by electronic transfer of data and funds. Using IT the degree of collaboration can be increased with the use of telecommunication tools such as e-mail, video conference and file transfer.

### **3.6 Knowledge Management**

In order to reduce the amount of tacit knowledge in the organization and maximize the amount of explicit, codified knowledge IT is very important. High quality, reliable and fast information systems need to be in place that can be used to access codified reusable knowledge. According to Daft a 'people-to-document' approach is required. This means that the focus has to be on collecting and codifying knowledge and storing it in information systems where it can easily be accessed and reused by anyone in the organization. The 'knowledge' has to be gathered from persons and stored in the IS (Daft, 2001).

### **3.7 Conclusion**

In this chapter different theoretical concepts are introduced. The concepts are divided into three parts.

- *Methodology*; the business process redesign methodology is introduced in paragraph 3.1. This methodology is used to design the required business processes for the inbound logistics, while making use of the benefits of the support of IT.
- *Benefits of IT and managing IT projects*; in paragraph 3.2 – 3.4, important concepts for the management of IT projects are introduced.
- *Organizational theory and information management*; the design of the business processes depends on the structure of the organization. Drawbacks and benefits of different organizational alternatives are therefore discussed in paragraph 3.5 Section 3.6 explains how transparent business process designs help in the communication and transfer of knowledge in the organization.

The concepts introduced in this chapter will be applied throughout the rest of this report.



## **4 Analysis**

To initialize the design of the business processes for the inbound logistics at Catalysis the process is analysed from three different perspectives. First the basic business logic behind the processes §4.1 is discussed. Why is it important for Catalysis to develop clear processes? To answer this question the importance of the process design is discussed from a practical point of view. The use of the process designs on a daily basis is discussed in §4.2. Chapter three discussed relevant concepts from scientific literature for this research. These concepts indicate how clearly designed business processes help in making the business successful. The findings are presented in §4.3. It is important to use a design method for the business processes that suits the intended use of the designs. An appropriate design method is selected in §4.4. The business process redesign (BPR) method is used to structure the remainder of the research. How BPR is applied is discussed in §4.5.

### **4.1 Business Logic**

Catalysis is going to recycle spent catalysts from mostly the petrochemical industry. From these spent catalysts a number of raw materials will be recovered. Fondel Metals and Catalysis-AG have signed a trade agreement, in which is established that Fondel Metals will have sole distributorship of the products produced by Catalysis (Fondel & Catalysis, 2007).

To be able to start production, waste has to be bought from waste supplier and transported to the plant in Germany. When recycling has been completed, the finished products are sold by Fondel Metals to one of their customers.

### **4.2 Practice**

Fondel Development and Catalysis feel the need for clearly designed business processes for a number of reasons. First of all, the waste producers have the responsibility to dispose of their waste in an environmentally responsible way. In order to trade with these waste producers Catalysis has to become a trustworthy partner. Clearly defined, transparent business processes help to achieve this. Also because of this trust issue, a waste recovery company is expected to have an ISO 9001:2000 certification showing that they are actively managing the quality of their operations. The designed business processes form a basis to start the application procedure for such a certification.

Next to the trust from the customers and needed certifications Catalysis also needs different permits from the local authorities. These permits allow Catalysis to actually perform their operations. Currently Catalysis is working on the application of these permits. The director of Catalysis aims to operate the plant as transparent as possible towards to the local authorities he is also going to use the business processes for these permit applications.

When the plant will become operational, personnel that manages the daily operations has to be hired and educated. The developed manual will be used in this educational program. Besides the relevance for new personnel the manual is also a way to ensure business continuity in the case of for instance loss of personnel because of illness etc.

The structured processes and the templates for letters and documents that are available in the manual will lead to improved business control and unambiguous communication towards customers and authorities.

### **4.3 Theory**

Next to the considerations as implicated by the practical field in which the processes will operate, insights from literature are important as well. In chapter three, different theoretical concepts have been discussed, how these concepts can be used in the design of the processes is discussed next.

Catalysis is a production company, according to Daft (2001) there is therefore a greater need for efficiency than for learning or innovation. Vertical linkages for information sharing are therefore important. For the business processes that are going to be designed this means that information should be well documented and made accessible throughout the whole process. In order to achieve this, specifications listing all data elements that need to be present in documents and files are created and included in the process manual see §6.8.

Catalysis needs to control all business processes in order to operate efficiently. To do so, it is recommended to use a functional structure in the organization. The strength of the functional structure is efficiency, the ability to accomplish functional goals, and to share in depth knowledge and skill development throughout the organization, see §3.5.2. The clearly defined business processes and the process manual contribute to these strengths by the codification of implicit knowledge making in tacit and transferrable, hence following the 'people-to-document' approach as discussed in §3.6.

### **4.4 Design Method Selection**

Based on the discussion in the previous three paragraphs and interviews with the managing directors of FD and Catalysis, a list of design criteria has been populated. These criteria are used to select an appropriate design method for the business processes in chapter 6.

### Design criteria

1. Because the processes that are going to be designed are new, they can be considered conceptual. The designs will have to function as a basis for actual process construction.
2. The finished designs have to be usable as reference for personnel in the different positions.
3. Requirements for system development have to be abstracted from the process descriptions.
4. Process designs have to be updated and maintained by people who have received none or very little process management / engineering training.
5. The processes have to be adaptable for other projects in the future.
6. The process descriptions have to be suitable for ISO 9001:2000 audits.

Next to the considerations there are a number of general criteria that are also important.

7. Quality of design (completeness, correctness)
8. Complexity of design procedure
9. Required development time
10. Necessary design tools (Visio, UML editor, etc.)

Based on the design goals and general criteria, three possible design methods have been selected for evaluation. These Methods are; Use Case Diagrams (Wieringa, 2008), Flowcharts (Aguilar-Savén, 2004; Giaglis, 2004) and Workflow techniques (Aguilar-Savén, 2004; Fischer, 1995; Gordijn, Akkermans, & Van Vliet, 2000).

The different methods are scored on the predefined goals for the process descriptions and the general criteria. These scores are presented in table 4. Where '--' refers to a poor score, '-' moderate, '+/-' average, '+' good and '++' refers to an excellent score (Van Vliet & Van Vliet, 2000).

Method / Criterion	1	2	3	4	5	6	7	8	9	10
Use Case Diagrams	++	+/-	+	--	+	+/-	++	-	--	+
Flowcharts	+/-	++	+/-	+	+	+	+	+	+	+
Workflow	+/-	+/-	+	-	+/-	+/-	+	-	+/-	-

**Table 4: Selection of Process Design Method**

Based on these scores, the Flowchart based process description has been selected to serve as design method. The major benefits of flowchart based descriptions are the flexibility of the modelling technique and its communication ability (Aguilar-Savén, 2004; Giaglis, 2004). This makes the technique usable for all different processes in the project and allows for use of the process descriptions as instruction and reference guide for personnel. The flowchart method is an excellent choice when dealing with processes that need a high level of detail. Known drawbacks of the flowchart technique are its inability to make a distinction between main and sub-activities and tendency of the models to become very large (Aguilar-Savén, 2004; Giaglis, 2004).

#### **4.5 Business Process Redesign Applied**

For the design of the processes the Business Process Redesign (BPR) method is used. This method is introduced in §3.1. The BPR method has five basic steps (Davenport & Short, 1990):

1. Develop a business vision and process objectives
2. Identify the processes to be redesigned
3. Understand and measure the existing processes
4. Identify IT levers: awareness of IT capabilities can and should influence process design
5. Design and build a prototype of the new process

Currently there are no existing business processes at Catalysis as the recycling plant is not operational yet. However, the managing director of Catalysis has a lot of ideas about the structuring of the daily business. Therefore the redesign that is done in this research is the translation of the ideas of the managing director into more structured and IT supported business processes.

The five steps as described by Davenport (1990) are used to structure the remainder of this report.

1. The business vision and process objectives have been described in chapter 2 as part of the overall objectives of this research. Objectives for the business process designs have been described in §4.4 as part of the selection process of a suitable design method.
2. Together with managing directors of Catalysis and FD the decision was made to focus on the design of business processes for the inbound logistics of Catalysis.
3. To be able to understand the existing ideas for the design of the business processes, multiple interviews and reviews of draft versions of process designs have been conducted, see §6.2.
4. The way IT can support the business processes has been one of the considerations in business process design. Because the role of IT within Catalysis / Fondel Development is not clear yet, a more elaborated discussion on this topic is presented in chapter 7.
5. The different business processes that have been designed are presented in paragraph 6.4-6.8.

## **4.6 Conclusion**

In this chapter the business processes that are going to be designed are analysed from three different perspectives. The business logic describes the goal of the process which is to purchase catalyst waister from the waste producer and transport of to Catalysis for recycling.

Based on practice and theory, designing clear business processes designs are important. The business processes are used to demonstrate the quality of service to waste producers and to apply for permits with local authorities. Also, the business processes play an important role in the training of new personnel. Designs therefore have to be unambiguous and easy to understand. Applying the theoretical concepts from chapter 3 showed that Catalysis can operate efficiently by enhancing the vertical linkages in the organization and by using a functional structure. The business process designs help to make this possible by standardizing the use of documentation and communication and by clearly stating the responsibilities of the different personnel in the organization. These important conclusions are used as input for the design framework of the business processes in paragraph 6.1.

Based on the method selection discussion in paragraph 4.4 the following research question can be answered;

*“What design method has to be used for the design of process descriptions?”*

The most appropriate design method for the business processes at Catalysis is a flowchart based description. This method requires little design effort and design tools such as software. Also, the finished designs are easy to comprehend for personnel and keeping the designs up-to-date can be done by people with limited experience in business process design.



## **5 Rules and Regulations**

In this chapter the different rules and regulations that are in force on the transboundary shipment of (hazardous) waste are discussed. These rules and regulations are very important for the inbound logistics of Catalysis. Catalysis is obliged to follow the procedures that are described in these rules and regulations. Before the business processes can be designed in detail, the relevant rules and regulations have to be identified.

For Catalysis, the rules and regulations that apply to a shipment depend on the country of dispatch of the shipment. There are three regulations that can apply to the shipments of spent catalysts, EC 1013/2006 regulation, the Basel I convention or the decision C(2001)107 by the Organization for Economic Co-operation and Development (OECD). A brief introduction of these three regulations will be given followed by more elaborated description on the procedure of prior written notification and consent.

### **5.1 The Different Regulations**

#### **5.1.1 Basel I**

In the late 1980s, a tightening of environmental regulations in industrialized countries led to a dramatic increase in the cost of hazardous waste disposal. Searching for cheaper ways to get rid of the wastes, “toxic traders” began shipping hazardous waste to developing countries and to Eastern Europe. When the activities were revealed, discussions on how to resolve these problems were held on a global scale. As a result of this, the first regulations on the movements of hazardous were drafted and adopted in the Basel I convention which was held on march 22, 1989 (Basel, 1989).

The Basel I convention is currently signed by 170 countries. By signing the proceedings of the convention the countries commit themselves to the rules enforced by the convention.

#### **5.1.2 OECD**

The OECD brings together the governments of 30 countries to improve the global economy by cooperation. The OECD provides statistics and economic and social data, forecast economic developments and research social changes and evolving patterns in trade, environment and technology. Amongst other activities, they assist governments in the coordination of domestic and international policies. The non-EU members of the OECD form a specific group within the European regulations for the shipment of waste.

#### **5.1.3 EC 1013/2006**

Within the European Union (EU) the regulation 1013/2006 concerning the transboundary shipments of waste has been in force since 12 July 2007. This regulation describes the precise process and procedures that need to be followed when a shipment of waste materials is going to take place.

Compared to its predecessor, the EU259/93 which was in place from February 1993 until July 2007, there is one important difference. Where the old regulation was using three classes of waste materials (green, amber, red) the new regulation only makes a distinction between green and red types of waste. Most of the waste materials that used to belong to the amber category are now listed in the red category. This is important to mention because a lot of organizations still refer to the old regulation on their website and/or in documentation. The way authorization for the shipment of waste is granted is different. For the waste that was listed on the 'amber' list, permission for transport had to be requested however, actual permission was assumed after a period of 30 days (implicit consent). In the 1013/2006 regulation, written consent has to be received before the shipment may take place.

## ***5.2 Procedures for the Transboundary Shipment of Waste***

Two procedures for the shipment of waste are in place in Europe. The procedure that has to be followed depends on the type of waste material that is being transported. As described in §5.1.3, there are two different categories of waste material; green and red wastes. The wastes are listed in annex III, IV & V of EC1013/2006 (2006).

In the case of Catalysis the recycled waste is spent catalysts. These spent catalysts can be found on both the green and red list of waste materials. However, if a specific type of waste is listed on the green list an additional stipulation has to be considered. If the waste is contaminated by other materials, to an extent which increases the risk associated with the waste sufficiently, it is rendered appropriate for submission to the procedure of the red listed wastes. The risks that need to be considered are the hazardous characteristics that are listed in annex III of directive 91/689/EEC.

All of the spent catalysts that are going to be recycled by Catalysis have at least the following two listed hazardous characteristics;

- Highly Flammable
- Carcinogenic (causes cancer)

Therefore the 'red waste' procedure always applies to the transports of Catalysis. This is the procedure of prior written notification and consent. This basically means that for every transport of waste materials, a notification has to be submitted to the authorities of all the involved countries. The country from which the shipment will be sent; the authority of dispatch, the country where the shipment will be sent to; the authority of destination and possibly the countries through which the transport will move; the authorities of transit.

After the notification has been sent, the authorities will make a decision on the approval of the shipment. A more detailed description of the procedure with an example of all the standardized documentation that has to be used can be found in the process manual described in §6.8 and in appendix IV.



### 5.3 Rules in Practice

According to the regulation EC1013/2006, (2006) the waste producer is responsible for the execution of the notification with the competent authorities. Executing the request proves to be a complex task and especially smaller waste producers are finding it a hassle. They lack the knowledge and experience about the different regulations and procedures. Therefore a lot of the catalyst recyclers are either providing support for completing forms or complete the notification on behalf of the customer. An overview of the major catalyst recyclers and their notification services is presented in table 5. The responsibilities are taken over from the waste producer by a registered broker with the catalyst recycler. To be able to do so, an authorisation request has to be send to the waste producer, who has to sign and return the request. Such a request is included in the process manual (Bax, 2008).

Company	Country	City	Authorisation Service
<b>Catalyst Recycling</b>	England	Staffs	Full Support
<b>Sadaci</b>	Belgium	Gent	Completing Forms
<b>Moxba</b>	Netherlands	Almelo	Full Support
<b>Eurecat</b>	USA	Houston	Full Support
<b>Nickelhütte Aue</b>	Germany	Aue	Full Support
<b>Gulf Chemical</b>	USA	Freeport	None
<b>Treibacher</b>	Slovenia	Ravne na Koroškem	Full Support

**Table 5: Notification Services of Catalyst Recyclers**

### 5.4 Conclusions

The rules and regulations discussed in this chapter form an important part of the inbound logistical processes of Catalysis. In this chapter is described which rules and regulations apply to the transports of waste that are going to be performed for Catalysis. The findings of this chapter are used as input for the design framework of the business processes in paragraph 6.1.

To conclude the discussion of the rules and regulations, the answers to the related research questions are formulated.

*“Which rules and regulations apply to the processes of inbound logistics at Catalysis?”*

In §5.1 the three relevant regulations for the transboundary shipments of waste materials have been introduced. Transports within the EU have to follow the rules and procedures as described in EC 1013/2006. Because Catalysis will initially focus on waste producers within the EU, this regulation is the most relevant. This is important for the business processes designed in the next chapter. The EC1013/2006 regulation defines exact procedures which have to be followed when a shipment of waste is executed. These procedures will therefore be described in detail in the designed business processes.

*“What procedures are dictated by these rules and regulations?”*

The procedure that has to be followed to execute a transboundary shipment of waste within the EU is the procedure of ‘Prior written notification and consent.’ This procedure is explained in detail in the ‘Manual inbound Logistics’ (Bax, 2008). A more general description of the procedure is given in §6.6.

*“What is the recommended role of Catalysis in these procedures?”*

Almost all catalyst recyclers provide support for the notification of a transport, see table 5 above. Especially smaller waste producers do not want to be bothered with managing transport and dealing with regulations. The overview of regulations in this chapter and the exact procedure that is described in process manual (see §6.9) can be used to execute a shipment of waste in the EU. Catalysis can therefore provide a (paid) service to customers for these notifications. This also allows Catalysis to keep in control of the notifications and prevent unnecessary delays during transport because of paperwork and bureaucracy.

## 6 Business Processes Design

This chapter will elaborate on the different processes that are required for the inbound logistics of Catalysis. First a framework for the design of the business processes is constructed based on the findings in chapter 4 and chapter 5. The process used to collect the necessary information and to review draft versions of the processes is discussed in § 6.2. In paragraph §6.3 - §6.8 the different sub processes will be briefly introduced. For the whole process, a manual has been developed the contents of which are described in §6.9.

### 6.1 Design Framework

In chapter 4 the business processes for the inbound logistics at Catalysis have been discussed from three different perspectives. The business logic, a practical point of view and considerations from the theoretical framework. This discussion results in a number of criteria for the design of the business processes.

#### 6.1.1 Business Logic

The business logic determines the reach of the inbound logistics process. The inbound logistics consider the process from acquiring the catalyst waste from the waste producer until the waste is received at the recycling plant at Catalysis, Halle, Germany.

#### 6.1.2 Practice

The intended use of the designed business processes produces some important requirements for the business process design. In the following enumeration the intended use of the process designs and related requirements for the business process design (process) are introduced.

- Catalysis has to become a trustworthy waste recycling partner for the waste producers, business process designs therefore need to be transparent.
  - o Clearly state who is responsible for the process
  - o Define escalation paths if normal process results in a deadlock
  - o Make sure that there no 'dead-ends' in the processes
- The business processes are used as a basis to apply for an ISO 9001:2000 certification
  - o Get approval of the designs by the internal auditor of Fondel
- The business process charts are used to train new personnel
  - o Provide a concise but clear description of subtasks
  - o Clearly state the inputs and outputs of the processes

#### 6.1.3 Theory

As discussed in paragraph 4.3 there are two requirements for the business process design based on the theoretical framework from chapter 3.

Because of the need for efficiency in the recycling process of catalysis, it is important to make the business processes well documented and available throughout the process.

Therefore templates for all documents that are needed in the different processes have been developed. For data stored in databases, a specification of the required attributes in this data has been made as well.

Catalysis uses a functional structure to operate efficiently. The implicit knowledge about the business processes is made shareable with the creation of the business process designs. To increase control throughout the process, people have been made responsible for different sub processes by stating this clearly on the business process designs.

#### **6.1.4 Rules and Regulations**

In chapter 5 the different rules and regulations that apply to a transboundary shipment of waste have been discussed. From this discussion became clear that the catalyst waste that is recycled by Catalysis falls under three different regulations. Which of these three depends on the country of dispatch from which the waste is transferred. Because Catalysis will initially focus on waste producers within the EU, the EC1013/2006 regulation is the most relevant. The procedures that are laid down by this regulation will be used in the business process designs for the inbound logistics. A summary of these procedures is also created. The summary is used to inform clients of the procedures and to show the expertise of Catalysis in the market. The summary is presented in appendix VI.

### **6.2 Data Collection and Review**

To get insight in the different processes that have to be designed, an interview / brainstorm session with the managing directors of Catalysis and FD has been held. After this session, draft versions of flowcharts of the different processes have been designed in Microsoft Visio. These draft versions are reviewed by three persons. The managing directors of Catalysis and FD, determined the validity and completeness of the process descriptions. Because the process descriptions will also be used in audits for an ISO 9001:2000 certificate, the quality controller and internal auditor of Fondel also reviewed and approved the draft flowcharts.

### **6.3 Sub Processes**

Based on the interviews with the managing directors of FD and Catalysis and the review of the relevant rules and regulation in the EU the processes for the inbound logistics have been designed.

The managing director of Catalysis told that the waste that is produced by the petrochemical companies is often contaminated with a vast variety of materials that have been introduced during the catalyst operations; either intentionally or by mistake. Catalyst waste is known to contain radioactive elements, plastics (high carbon levels), and different unexpected metals. Because the waste recovery process at Catalysis can be dramatically influenced by these contaminations and because Catalysis wants to be sure that they do not accidentally end up with waste that has to be disposed against high

costs, such as radioactive materials, knowing the composition of the catalyst waste is critical. This composition can be supplied by the waste produced or a test batch is sent to the laboratory of Catalysis for analysis (FD2). The concentrations of recoverable metals in the catalyst waste determines the profitability of the batch which is calculated in the batch calculation (FD3). Based on the test results and the batch calculation, a contract is made between Catalysis and the waste producer (FD1). This procedure minimizes the chance of a unsuitable or unprofitable batch of catalyst waste being accepted by a trader of Catalysis.

The procedure of prior written notification and consent (FD4) is used within the EU to apply for a approval that is required to execute a transport of catalyst waste.

When the waste material arrives at the Catalysis plant, it is tested again to make sure that the composition is exactly as expected (FD5).

The sequence of the different sub processes (FD1-FD5) is presented in figure 4.

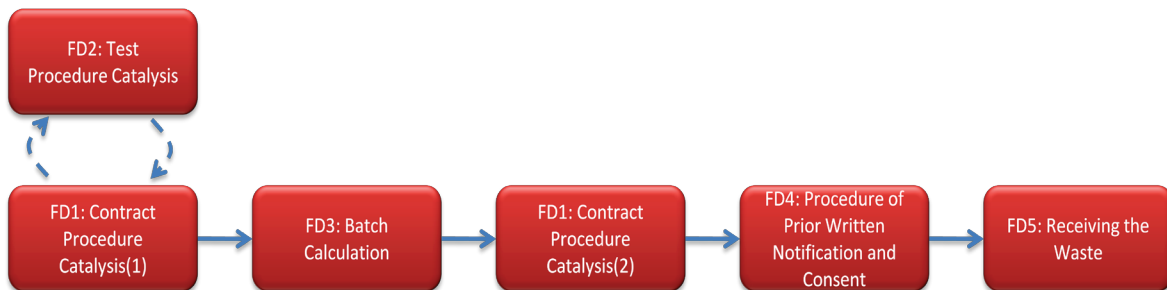


Figure 4: Overview of Inbound Processes

A brief description of the different sub processes will be given next. A more detailed description of all the processes can be found in the appendixes of this report.

#### 6.4 Contract Procedure Catalysis

This is the initial process for the trade of a batch of Catalyst waste. The trader of Catalysis contacts the waste producer and information about the size and specification of the batch is received from the waste producer. If the specification is incomplete or an unapproved analysis technology/procedure has been used to compose the specification, a test procedure is initiated (FD2). The specification is checked to see whether it is technically feasible to recycle the material.

Based on the specification and current market prices a profit calculation is performed (FD3). Based on this calculation, a decision is made whether a quotation will be submitted. If so, a quotation will be composed and send to the waste producer. If not, information about the offered batch, waste producer and reason for rejection will be saved for future use.

## **6.5 Test Procedure Catalysis**

Based on the information that is received in the contract procedure a decision is made whether a test procedure is initiated or not. The test procedure begins with the formulation of a request to send in a sample of the waste material for testing. Attached to this request are labels for the sample, ensuring proper handling of the sample by the postal service.

When the sample is received at the laboratory of Catalysis, the sample is prepared and analyzed in two machines; a XRF and a LECO test machine. The XRF machine is used to find out which elements are present in the waste material and what their concentrations are. In spent catalysts there is a high concentration of carbon and sulfur. The precise concentration of these elements is important because these elements are burned during the recycling process and this percentage of waste material is therefore lost. The LECO test can be used to determine the percentage of carbon and sulfur in the waste material.

Based on the results of the XRF and LECO test the laboratory develops a test report. In this report the found elements and their concentrations are listed. Also the laboratory will give advice about the technical feasibility of the recovery of this material. The recycling plant of Catalysis has been designed for a certain scope of spent catalysts. The precise composition of the waste material determines the efficiency of the recycling operations.

## **6.6 Batch Calculation**

In order to present a quotation to the waste supplier a calculation has to be made. To be able to do so a excel sheet has been developed that summarizes all the essential data and performs a calculation resulting in a gross profit margin. The input for this calculation consists of the following different elements:

- concentration of the different valuable metals in the waste
  - o Vanadium
  - o Cobalt
  - o Nickel
  - o Molybdenum
  - o Wolfram
- The current market price of the valuable metals source;
  - o Ryan's Notes: Vanadium, Molybdenum, Cobalt
  - o London Metal Exchange: Nickel
- Percentage of carbon and sulfur in the batch
- Total weight of the batch

Next the trader can determine the different gross margins. These different margins are; the margin achieved by Fondel Metals with the sales of the finished products and the margin for the recycling operations of Catalysis.

The benefits for Fondel come from the sales of the finished products to their customers. The final sales price that Fondel manages to get from their customers is expressed in a percentage of the current market price. From this sales price a trade margin is retained by Fondel Metals and the rest is paid to Catalysis for the finished products. The trade margin is calculated according to a price scheme that is defined in a trade agreement between Catalysis and Fondel Metals (Fondel & Catalysis, 2007). Using the sales price that Fondel Metals receives for the finished products and the price that is paid to Catalysis, the gross margin of Fondel Metals can be calculated.

To determine the gross margin of the recycling operations of Catalysis, their costs and benefits need to be calculated. The benefits of Catalysis come from the sales of the finished products to Fondel Metals. The price and amount of finished products determines the total benefits. The managing director of Catalysis has decided to only include operational costs for the calculation of a gross margin for the development of quotations. Costs resulting from cost of capital or depreciation are therefore not included at this moment.

The operational costs consist of fixed and variable costs. All the fixed costs are listed in the 'fixed costs' sheet. The variable costs come from the use of chemicals, energy and water during recycling, and costs for the treatment of the different waste streams. The amount of variable costs is calculated for each batch, as the usage of the different chemicals and energy depends of the composition of the material. Based on the production capacity of the plant (currently 500KG/hour & 600 hours/month) the number days required for the recycling of the batch of catalyst waste can be determined. This number is divided by the number of production days annually (250) and multiplied with the annual fixed costs. The result is used as an indication of the amount of fixed costs that have to be covered by the recycling activities of the current batch.

### ***6.7 Procedure of Prior Written Notification and Consent***

This procedure describes all the information exchanges and document handling concerned with the request for permission to execute a transboundary shipment of waste within the European Union. An elaborated discussion about the different rules and regulations and a detailed description of the procedures and related documentation has been presented in §5.1.3 and in the process manual (Bax, 2008). To help the communication with customers a summary of the EU1013/2006 procedure has been made, this summary can be found in appendix VI.

## **6.8 Receiving the Waste**

When a shipment of waste arrives at the recycling facility of Catalysis this procedure is used to check-in the shipment.

Upon arrival of the truck containing the batch is weighed on a truck scale to determine the total weight of the combination. Then the truck continues to the dock to be unloaded. After unloading the truck is weighed again to be able to determine the weight of its load.

The shipment is put in quarantine until all requirements have been fulfilled. The documentation that is accompanying the shipment will be checked to see whether all documents are present, properly filled in and signed. If so, a sample will be taken from the shipment. To do so, from every 20<sup>th</sup> barrel of the shipment a small amount is collected in an empty, clean barrel. The material is mixed and sent to the laboratory for testing. In the lab a XRF and LECO test is performed just as it is performed in procedure FD2. The results of these tests are then compared to either the specification of the batch as it was supplied by the waste producer in procedure FD1, or, if available, to the results of the test procedure FD2 that has been performed in a sample of the material. Only if the results show the same composition and concentration of elements the shipment will be checked-in. If this is not the case, the waste producer will be contacted to discuss how the abbreviations in the waste material will influence the recycling procedures and costs.

Finally, a confirmation of the receiving of the waste material will be send to all involved competent authorities as mentioned in §5.2. This confirmation has to be send within 3 days after the waste is received.

## **6.9 Process Manual**

After the flowcharts of the different processes were finished and approved by the managing directors of both FD and Catalysis, work started on the development of a manual for the whole process of inbound logistics at Catalysis. In this manual the following documents can be found;

- The developed flowcharts
- An general introduction for the whole process
- Introduction on the different sub processes
- A specification for the different documentation used in the processes
- Templates for all the correspondence that is going to be used
- Checklists for each of the sub processes listing all tasks

As described in §1.1, Fondel Development is currently working on multiple projects concerned with the recycling / recovery of waste materials. At the moment none of the projects have actually started production yet. The manual that has been developed for the inbound logistics at Catalysis will also function as a reference book for the other projects at Fondel Development.



## **6.10 Conclusions**

In this chapter the different processes related to the inbound logistics of Catalysis have been introduced. Based on this discussion the following research question can be answered;

*“What are the different processes that are required for the inbound logistics?”*

As has been discussed in paragraph 6.2, the inbound logistics at Catalysis has been structured in five sub processes. Together these sub-processes cover the process from the time that a batch of Catalyst waste becomes available at a supplier’s location until this batch has been received and approved at the Catalysis plant in Germany. To be able to make sure that the waste material is suitable for recovery, the material is analysed multiple times. Permission for transport is handled by the procedure of prior written notification and consent which has been described in detail in sub-process FD4. And the procedure that is followed to make a contract for waste recovery is designed to minimize the chance of unsuitable waste batches being bought by Catalysis.



## **7 Benefits of IT and Managing IT Projects**

### **7.1 Current Situation**

As described in §1.1, Fondel Development is a young, ambitious organization that is working on multiple projects. Currently all the recycling facilities that are being developed in the different projects are not operational yet. When these facilities are operational, FD wants to be able to keep track of their performance. Also FD wants to have the ability to have a leading role in the trade of waste materials that are going to be used as input for the different recycling operations. To be able to do so, information exchange between FD and the different facilities has to be arranged. Because the market prices of metals can be volatile, the timely delivery of finished products and the ability to make good predictions on the availability of products in the near future is important for trading. The information exchange with the Fondel Group as a whole is therefore of great importance for the success of the business.

The effective use of IT can help to facilitate FD and the Fondel Group in their needs for information exchange. The business development projects of FD all concern new organizations. For each of the projects, separate companies are being founded. This means that there are no legacy systems in place. The core business of FD is the development of new businesses in the recycling industry. When the business is operational and successful, FD will try to attract new investors. By selling the business, capital for investments in other, new projects will become available. It is therefore important to use information systems that can be sold along with the company.

Currently an old system is being used within the Fondel Group to handle trading, planning and back-office operations. This system is called All-Trade and is going to be replaced in 2009. For this new system Fondel has been working on the selection of a suitable replacement and capable system integration partner. The new system will consist of an ERP package with an additional module that was specifically designed for the trade of primary and secondary metals. There is a limited set of suppliers that is developing and selling modules that can satisfactory support the trading operations of Fondel. Currently there are two potential suppliers for the ERP system. One supplier is offering a SAP based system and the other supplier a Microsoft (MS) Dynamics AX based system. Both systems fulfil the requirements of the Fondel Group. However, the quotation of the SAP system is considerably higher than the MS based system. It is the policy of the IT management within Fondel to prefer MS based software to be able to maximize standardization and ease of information exchange. IT management and the All-Trade replacement project manager within Fondel both expect that Fondel is going to buy and implement the MS Dynamics AX based solution.

## **7.2 Benefits of IT supported Business Processes**

If the new ERP system that supports the daily operations of the business processes at Catalysis and Fondel Development will be implemented on time and according to specification, there are a number of benefits that have been identified in literature, that can be expected.

Oz lists a number of benefits that can generally be linked to the implementation of an information system (IS) that enables electronic data interchange (EDI) (Oz., 2004):

- Cost savings
- Speed
  - o Real time information
- Accuracy
- Security
- System integration
- Just-in-time support

The operations at Catalysis have a low gross margin. Controlling cost levels is therefore essential. The market prices of primary and secondary metals are volatile and these prices mainly determine the margins that Catalysis makes on their operations. To be able to control cost levels, FD is going to have a leading role in the trade of the spent catalysts and finished products. The ERP system can be used to collect information about the production planning, cost levels and market prices of metals accurately and in real time. To be able to do so it is essential that FD and Catalysis are using a standard for information exchange that supports this.

As discussed in §3.5.3, organizations have to try to reduce the degree of mediation and increase the degree of collaboration in their processes. Catalysis has a strong linear structure in their main process, however from an information point of view increasing collaboration is indeed possible. Information systems, making use of shared databases, can help to make information available throughout the production process helping to decrease the degree of mediation. By decreasing mediation, Catalysis becomes more flexible allowing them to make better use of the available production capacity.

## **7.3 IS related Critical Success Factors**

To be able to achieve the expected benefits as described in §7.2, Fondel needs to consider more factors than only the selection of a suitable and capable system. Fondel is a relatively small but complex organization divided into multiple companies and spread across multiple locations. The implementation of a new ERP system is a complex task because of the specific market and the scattered organization of Fondel. In order to maximize the chance of success import lessons from the past are vital to consider in this project. Table 3 lists important Critical Success Factors identified in literature specifically for SMEs. The most relevant CSFs are discussed next.

### **7.3.1 Top Management Support**

Strong leadership is required to make sound decisions, support the directed heading of the company and to help with change management and system rollout (Al-Mashari, Al-Mudimigh, & Zairi, 2002; Umble, Haft, & Umble, 2003). Participation of top management will ensure that the project has been approved by them and will be aligned with the strategic business goals (Nah, Lau, & Kuang, 2001). Moreover top management commitment is necessary to provide the relevant and necessary resources throughout the project (Holland & Light, 1999; Nah, et al., 2001).

A side effect of the support of top management is the presence of a project champion, the role of the project champion is to promote the project in the organization and create enthusiasm for the project (Poon & Wagner, 2001; J. Scott, Globe, & Schiffner, 2004). An effect of this enthusiasm is increased commitment of the users for the project which increases the cultural readiness for the IS implementation in the organization (Poon & Wagner, 2001).

Within Fondel, top management is very much supporting the move towards a new ERP system. They understand that the different legacy systems are reducing business performance at the moment and will not have enough functionalities to successfully support the new business processes that will commence once the different production plants in the projects of FD become operational. The top management is involved in discussions with supplier candidates and they encourage key users from the personnel to participate.

### **7.3.2 Timing and Planning**

For many SMEs IS projects can take a lot of their time and resources. Because there is little redundancy in the organization, little alternatives are available when employees are assigned additional tasks to support development efforts. Levy argues that *"SMEs may not be able to respond to the introduction of strategic IS due to limited resources, including implementation and training."* (Levy & Powell, 2000). Timing and planning is therefore essential, especially in small organizations. Planning refers to the making of structured and feasible time lines, mile stones and expectations for your project. The timing of the project refers to the tactical planning of major events in your project. It is for instance not advisable to start an implementation just before or during the busiest time of year for the organization (Aladwani, 2001). Without a good planning with a clear vision and strategic goals during the entire project, the project can become in danger as well. From the vision and strategic goals measurable project objectives can be derived. Well defined project objectives will help to keep the project on track and will give a structured base for the project team (Al-Mashari, Al-Mudimigh, & Zairi, 2003; Holland & Light, 1999).

The Fondel group has been working on the selection of a new ERP system since the beginning of 2008. This process has to speed up. Catalysis is planning to start production in the first half of 2009 and other projects within Fondel Development will start shortly after. To make sure the new ERP has been implemented and is running correctly and to prevent major chaos as a result of faulty systems, the implementation of the new system has to take place as soon as possible.

### **7.3.3 End User Involvement**

End-user involvement is widely considered as one of the main CSFs for IS development. This involvement is achieved by for instance training sessions and user workshops. Training is a form of end-user involvement and participation. Training also helps in the communication of perceived benefits (which is another CSF) because the future users of the system get acquainted with the possibilities of the new system (Solomon, 2005).

A lot of end-users do not see the advantages of the new systems. Company policies and procedures are often used for many years, and seem to work quite well for daily business. To be able to understand the advantages of system improvements, out of the box thinking is sometimes required. User involvement and training can facilitate in this requirement.

The IT department of Fondel is already involving future users of the new system in the selection and design of the new system. These key users will be 'idea champions' towards future users. This can help to reduce complications as a result of insufficient change management and an organizational culture that is not capable of handling the changes that will come.

### **7.3.4 Effective Communication**

During an IS project it is important to keep everybody involved informed about the developments. Using unambiguous and effective communication improves the support of the project throughout the organization and therefore reduces the resistance to change (Al-Mashari, et al., 2003; Holland & Light, 1999; Nah, et al., 2001; J. E. Scott & Vessey, 2002).

However it has become clear that the management of Fondel Development was not even aware of the new information system that is being selected. Communication has to be improved throughout the organization. Involved personnel will be confronted with rigorous changes once the different production plants of Fondel Development become operational. To make these changes smooth, cultural readiness has to be stimulated by involving more key users and using transparent communication throughout the organization.

### **7.3.5 Centralization of IS management**

To be able to efficiently trade metals, the availability, accuracy and timeliness of information is critical. The centralization of IS management can help to achieve these business needs. Centralization improves the ability to standardize hard- and software systems and the planning of shared systems. The costs of IT can be better controlled and distributed amongst the different parts of Fondel helping to reduce the cost levels of IT (Oz, 2004).

## **7.4 Conclusion**

In this chapter the current situation at Fondel Development from an IT perspective has been discussed. The specific IT related needs of FD in the Catalysis project and important critical success factors for FD to consider when working on IT related projects have been introduced. To conclude the discussion in this chapter, the following questions can now be answered:

*“What are the IT related needs of Fondel Development?”*

Fondel Development is currently working on multiple projects in the recycling industry. They focus on the development of the business, helping recycling technology developers in R&D and business development activities. The operational management of the production plant does not belong to the business focus of FD. Buying the waste from the waste producers that is needed for recycling and selling the finished products after recycling is going to be managed by the trade department of the Fondel Group. To reduce the risk in trading, the availability, timeliness and quality of information is very important. Information exchange between Fondel and the different factories is therefore vital for success. Fondel is selecting a replacement for the system that is currently used by the trading department. Fondel Development has to become involved in this selection process as soon as possible.

*“What are the benefits of supporting business processes with IT?”*

As mentioned above, FD wants to use IT to support information exchange between them and the different production plants. The information is used to support the traders at Fondel and to keep track of the performance of the different plants. Because of the low margin on the recycling operations of Catalysis, cost levels need to be controlled tightly. The information system will be used to collect information about the production planning, cost levels and market prices of the different metals, allowing FD and Catalysis to optimize the planning of production, purchase of spent catalysts and the sales of finished products.

*“What are the CSFs for successful IT projects within the Fondel Group?”*

To maximize the chances for success for IT projects in the Fondel Group, the most important CSFs have been introduced and the current state of these CSFs in the Fondel organization has been discussed.

- Top management of Fondel is supporting the IT department in their major projects such as the selection of the new ERP system. They participate in discussions and encourage key users to participate as well.
- Timing is essential in large IS projects, especially in small and medium enterprises. Fondel has to make sure that the new ERP system is implemented and problem free once the production facilities at Catalysis start recycling catalysts. The new ERP system project in the Fondel Group has to speed up in order to be ready on time. Of this will not be the case, Catalysis will have to start production without proper support of the ERP system.
- The IT department of Fondel is actively involving the future users of the new ERP in the project. These users are called the ‘key users.’ Apart from helping the IT department to collect all requirements of the future system, the key users also act as idea champions in the different departments at Fondel. They therefore help to reduce the resistance of other users for the new system.
- Communication is a very important factor in the success of IT projects. The management of FD did not know that the top management of the Fondel Group is selecting a replacement for the current trading information system. Communication about this project needs to be improved, to make sure that everyone who is going to be using the new system knows about the developments. This helps to create support for the project, also it prevents divisions such as FD from selecting systems of their own.
- Fondel has to make use of one central IT department. This allows them to use standardized hard- and software systems and reduces the cost levels because the overhead is spread in the whole organization.



## 8 Conclusions

This research aimed to answer two research questions. To structure the report, these questions have been divided into three categories; rules and regulations, designing business processes and IT support within Fondel. Throughout the report, at the end of the different chapters, the sub research questions from the different categories have been answered. To make the overall conclusions of this report concise and to-the-point the main research questions will now be answered. For a more elaborate discussion about the conclusions, please refer to the last paragraphs of chapters 4, 5, 6 and 7.

The two main research questions of this report were;

***“What is the appropriate arrangement for the inbound logistics of Catalysis, considering the various relevant rules and regulations in the EU?”***

It is important that Catalysis uses standardized processes for a number of reasons;

- to instruct future personnel
- to create the necessary trust with waste producers
- to improve transparency towards local environmental authorities
- to apply for permits with the local authorities
- to apply for an ISO 9001:2000 certification
- to increase the control and efficiency of the process

The different processes of the inbound logistics at Catalysis have been designed using flowcharts. These designs are presented in a process manual (Bax, 2008). For the correspondence with customers and authorities, templates have been developed and are also added to the manual. The waste that is recycled by Catalysis falls under the red list of regulation EC 1013/2006 of the European Union. Because catalyst waste is known to be contaminated with all kinds of unwanted and dangerous metals and chemicals, it is important to check every batch of waste material, prior to shipment and again on arrival. It is recommended that Catalysis provides a (paid) service to its waste suppliers for the arrangements of the transport. This reduces the chance of any hick-ups and allows Catalysis to make this necessary expertise beneficial.

***“What are the benefits for Fondel Development from supporting business processes with IT and how can Fondel Development achieve these benefits?”***

To improve the chance of success in the operation of their projects, Fondel Development needs information that is accurate, up-to-date and of high quality. This allows them to achieve a good trade margin on the purchase of waste materials for recycling and the sales of the finished products. The Fondel Group is looking for an ERP system that can replace the system that is currently supporting their traders. Fondel Development should participate in this process and use it for their different projects. To make this new system a success, the system has to be selected and implemented before the Catalysis plant becomes fully operational. The selection process therefore has to speed up. The management of the Fondel Group has to improve the communication about the new information system, this helps to create support and prevents sub divisions from looking for systems of their own. Furthermore for standardization of hard- and software and to reduce the cost levels, the Fondel Group has to make use of one centralized IS management department.

## 9 Recommendations

Next to the conclusions that have been presented in the previous chapter, there are a number of points of interest to extend the work of this research and a number general recommendations based on my experience within Fondel.

It is recommended to adapt the manual for the inbound logistics to cover other processes within Catalysis, such as outbound logistics and production. Besides other processes within Catalysis, Fondel Development can also adapt the manual for other projects they are currently working on such a ReOrbis, Inashco and battery recycling. By doing so, they are able to standardize processes and communication, leading to improved process control, cost reductions and transparency.

The application that is required to get permission to execute the transport of dangerous waste materials such as spent catalysts can be difficult. The complex framework that is defined by the different regulations in the EU and the large number of documents involved, combined with a number of deviations that are possible, makes the application complex and extensive. With the expertise that Catalysis has in-house and the flowcharts of the regulations that have been made in this research, these applications can be handled efficiently and effectively. Providing support towards customers for these applications reduces problems that occur in the application and improves the competitive edge of Catalysis in the market.

As described in §7.3.3, timing of the implementation of new information systems is essential for business success. It is therefore recommended to Fondel to speed up the selection and implementation of the new ERP system to make sure this system is up and running before Catalysis and other projects within Fondel Development become operational.

The management of Fondel Development was not aware that other people within Fondel were working on the selection of a new ERP system. Transparent and sufficient communication is considered one of the main CSFs for ERP project success (§3.4). Improving communication within the Fondel group is strongly advised. This can be for instance done by making use of the intranet capabilities or periodical internal mailings.

As described in §3.6 the 'people-to-document' approach can be used to codify knowledge and documents, making them reusable for future projects. To make a good start, all documents and results of this research are presented in a HTML webpage. Using this webpage all documents are directly available and there is no need to search through the whole folder structure in the network drive. FD can use this approach for future projects making it easier to (re)locate information eliminating unnecessary redundancy of information search of development.



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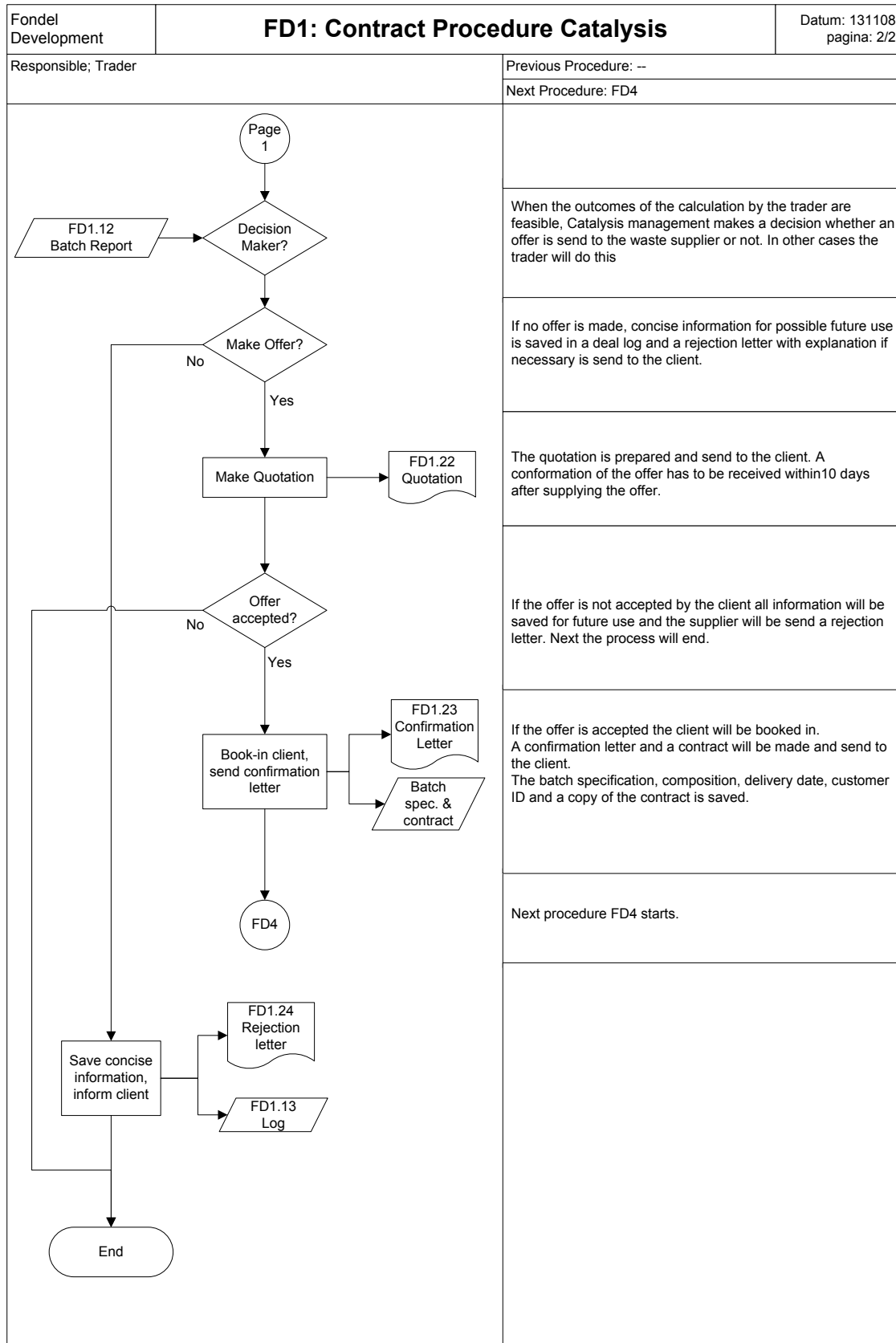
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# Appendix I: Contract Procedure Catalysis

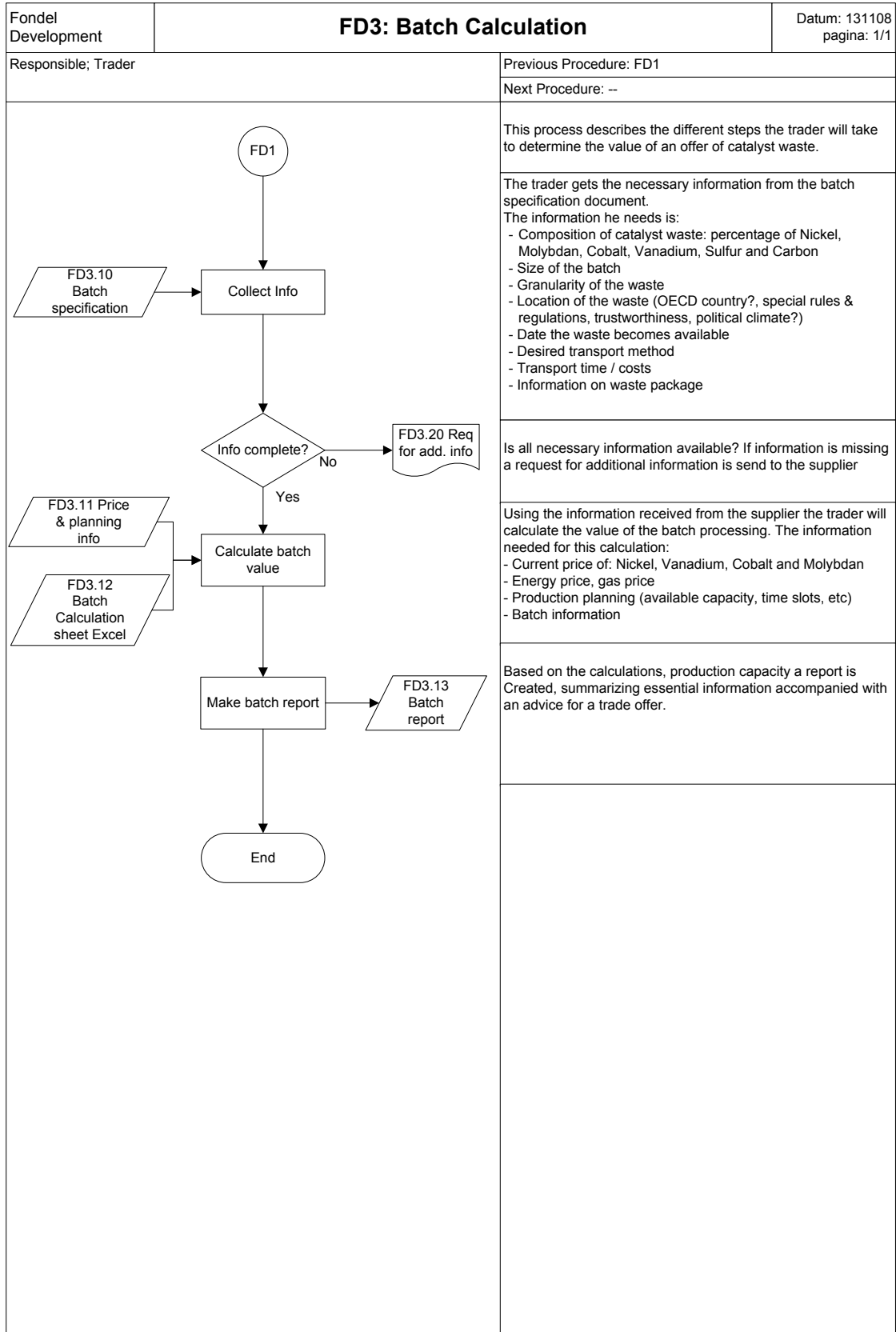
<p>Fondel Development</p>	<h2>FD1: Contract Procedure Catalysis</h2>	<p>Datum: 131108 pagina: 1/2</p>
<p>Responsible: Trader</p>		<p>Previous Procedure: -- Next Procedure: FD4</p>
<pre> graph TD     Start([Start]) --&gt; Info{Information complete?}     Info -- No --&gt; FD120[FD1.20 Request for additional inf.]     Info -- Yes --&gt; DIN{According to DIN+Complete}     DIN -- No --&gt; FD2((FD2))     DIN -- Yes --&gt; Collect[Collect and Save data]     FD111[/FD1.11 Test Results/] --&gt; Collect     Collect --&gt; FD121[/FD1.21 Test Results/]     Collect --&gt; FD310[/FD3.10 Batch specification/]     Collect --&gt; NoElem{No elements 2.5 &amp; 2.6}     NoElem -- No --&gt; End([End])     NoElem -- Yes --&gt; Mixture{Mixture within criteria 2.3}     Mixture -- No --&gt; End     Mixture -- Yes --&gt; FD3((FD3))     FD3 --&gt; Page2((Page 2))     Page2 --&gt; End     </pre>		<p>This flow sheet describes the initial process of a possible offer at Catalysis-AG. All references in this flow sheet refer to the articles as used in "General Conditions for The Recycling of Catalysts" Unless where mentioned otherwise.</p> <p>A potential new offer can be received by different ways of communication. By telephone, fax, mail or other systems. The trader of Catalysis might be proactively searching for deals or deals can be offered to Catalysis based on the suppliers initiative.</p> <p>The trader checks whether all information about the composition of the catalyst waste is available (% Carbon, CnHm, Water, Sulfide, Aluminum, Molybdenum, Cobalt, Vanadium, Silicone, Arsenic, Iron, Chlorine, Phosphor, Fluor, Zinc, Titanium, Copper, Sodium, Wolfram, Metal Parts, Radioactive Components). If any information is missing, a request for additional information is send.</p> <p>If the information about the composition of the mixture is, incomplete or collected using non-DIN procedures, Catalysis-AG has the right to test a sample of the catalyst waste using a XRF machine. Thus, procedure FD2 will start.</p> <p>The results from the test at Catalysis or the batch specification as supplied by the waste supplier are entered in a batch specification for further use. A letter summarizing the test results is send to the supplier on request.</p> <p>Under no circumstance, catalyst waste containing any of the elements such as described in §2.5 and §2.6 will be accepted for recycling.</p> <p>The values of the different elements in the catalyst waste should be within the limits as mentioned in §2.3. However as is mentioned in §2.4, recycling catalyst waste with minor fluctuations exceeding the predefined limits is possible however, only after agreement from Catalysis.</p> <p>The trader determines the value of the offer using procedure FD3.</p>



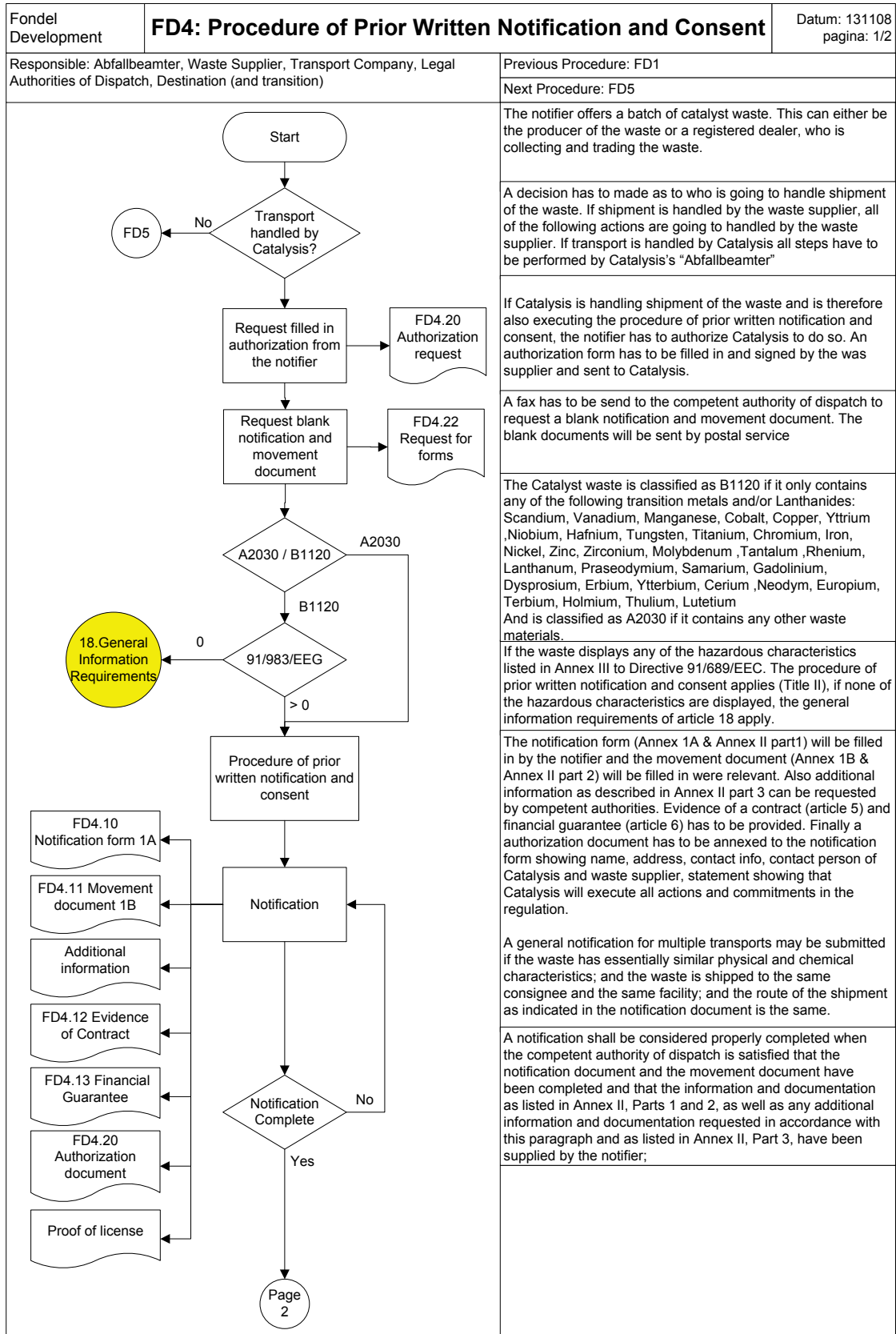
## Appendix II: Test Procedure Catalysis

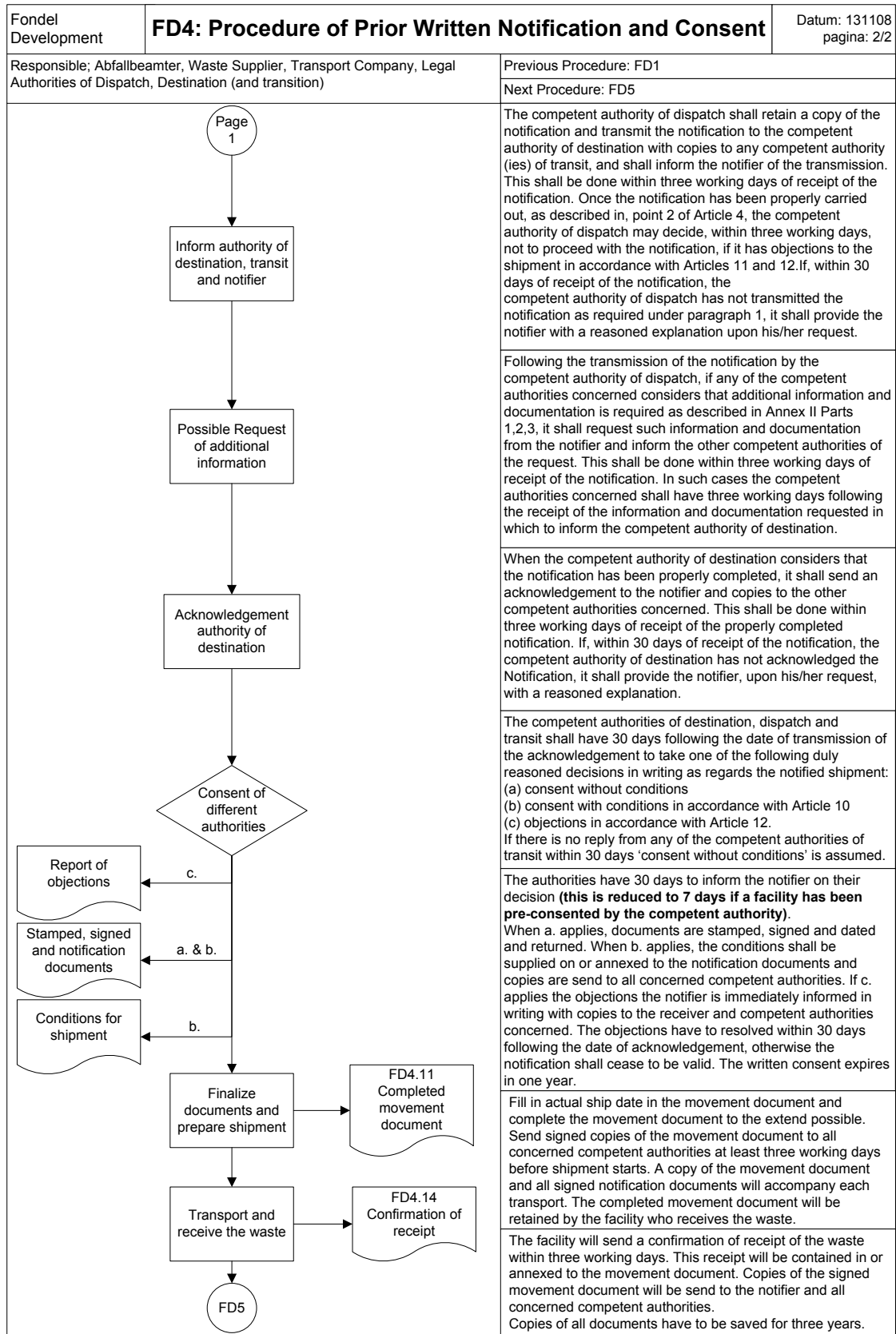
Fondel Development	<b>FD2: Test Procedure Catalysis</b>	Datum: 131108 pagina: 1/1
Responsible: Laboratory		Previous Procedure: FD1
		Next Procedure:
<pre> graph TD     Start([Start]) --&gt; Request[Request sample from the manufacturer]     Request --&gt; FD220[FD2.20 Request for sample]     Request --&gt; FD210[FD2.10 Labels for sample]     Request --&gt; Testing[Testing]     FD220 --&gt; WasteSupplier[Waste Supplier]     Testing --&gt; FD211[/FD2.11 Test results/]     Testing --&gt; End([End])     </pre>		<p>This procedure describes the test procedure at Catalysis that is performed in case the composition of a certain batch of catalyst waste is unknown or examined using test procedures not according to DIN standards.</p>
		<p>The supplier of the catalyst waste is requested to send in a sample of the waste for testing. Labels for packaging and transport are sent with the request. The maximum amount that, according to the regulations in place, can be sent as a test sample is 25 KG.</p>
		<p>In the test department at the Catalysis plant the sample will be analyzed in a XRF and LECO machine. The results of this test will be saved for future use for contract agreement. Also the tester will give advice on the technical feasibility for recovery of the batch.</p>

## Appendix III: Batch Calculation

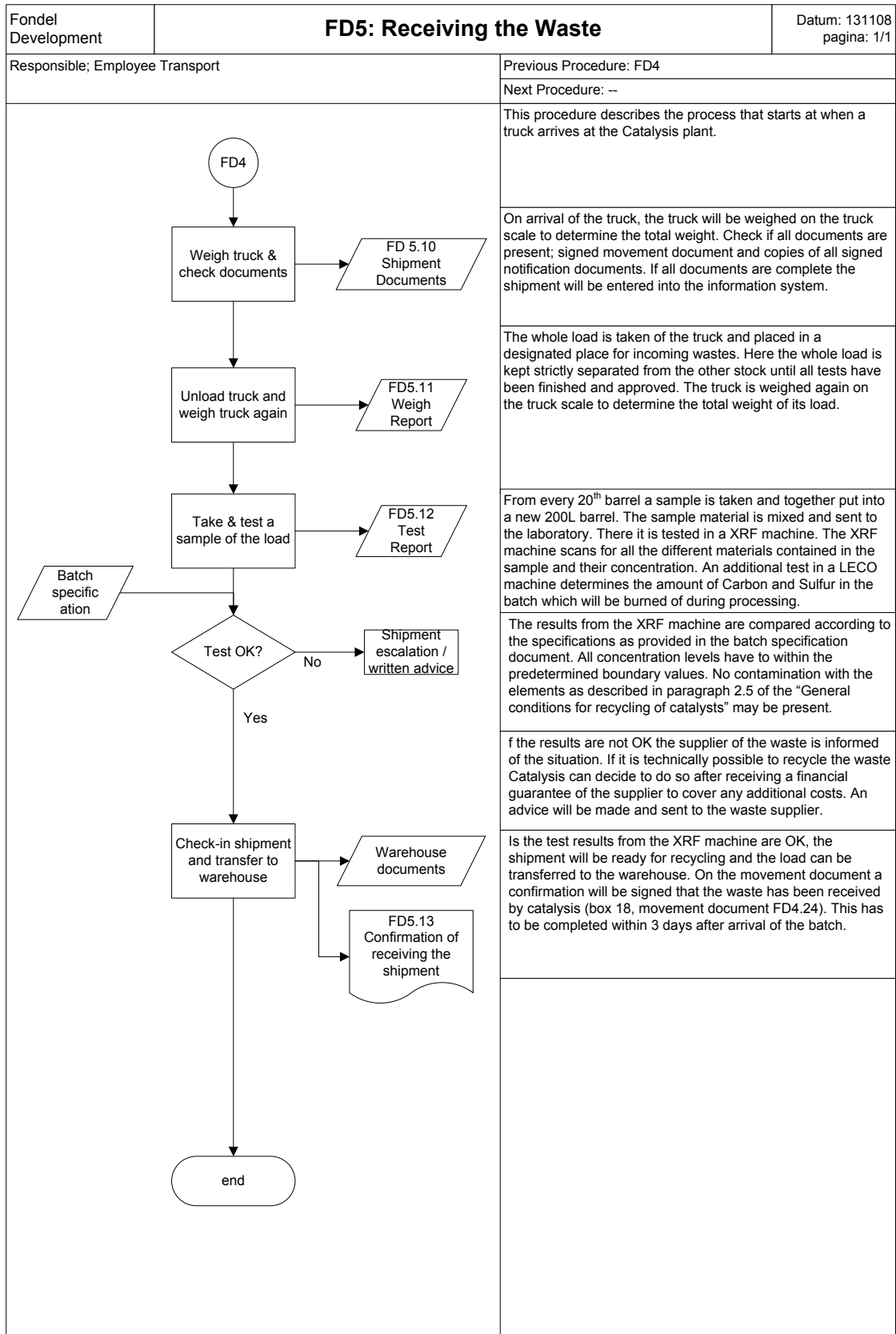


## Appendix IV: Procedure of Prior Written Notification and Consent





## Appendix V: Receiving the Waste



## Appendix VI: Summary EC1013/2006

Catalysis - AG	Procedure of Prior Written Notification and Consent	Datum: 04/11/08 pagina: 1/1
<p>This document describes the process that applies to the border-crossing shipment of hazardous waste destined for recovery as described in directive EU 1013/2006</p>		
<p>The following definitions have been used in this document:                      - Notifier: Natural or legal person who intends to carry out a shipment of waste or intends to have a shipment of waste carried out and to whom the duty to notify is assigned. This can be the producer of the waste or Catalysis-AG                      - Facility: Catalysis-AG                      - Competent Authority: the body designated by that country as the competent authority for the purposes of the Basel Convention</p>		
<p>1. After the order or intention for an order has been made the shipment of waste has to be notified with the competent authorities.                      In order to do so, the notification form has to be filled out completely. Also the movement document has to be filled out to the extend possible. Together with the notification and movement documents an evidence of contract and financial guarantee has to be provided.                      The authority of dispatch checks whether all documents are in order.</p>		
<p>2. The authority of dispatch has 3 working days following the receipt of the notification to inform the authority of destination and possible authorities of transit.                      The authority of dispatch shall retain one copy of the documents and sent copies to the other authorities. Also the notifier will be informed when the copies have been sent.</p>		
<p>3. The authority of destination has 3 working days to sent an acknowledgement when the notification is considered properly completed. Copies of this acknowledgement are sent to the other authorities and to the notifier.</p>		
<p>4. The competent authorities of destination, dispatch and transit shall have 30 days following the date of transmission of the acknowledgement to approve the shipment of waste. <b>(this is reduced to 7 days if a facility has been pre-consented by the competent authority).</b>                      If there is no reply from any of the authorities of dispatch or destination within 30 days, disapproval of the shipment is assumed.                      If there is no reply from any of the competent authorities of transit within 30 days, approval of the shipment is assumed. The authorities will sent copies of their decision to the other competent authorities and the notifier. The written consent expires in 1 year.</p>		
<p>5. When the shipment is going to take place, the movement document is completed by filling in the actual shipment date. Signed copies of the movement document have to be sent to all concerned competent authorities at least three working days before shipment starts. A copy of the movement document and all signed notification documents will accompany each transport. The completed movement document will be retained by the facility who receives the waste.</p>		
<p>6. The shipment will take place on the date and following the route as indicated in the notification form. When the shipment has been executed, the facility will send a confirmation of receipt of the waste within three working days. This receipt will be contained in or annexed to the movement document. Copies of the signed movement document will be send to the notifier and all concerned competent authorities.</p>		
<p>7. The facility shall sent a certificate of recovery within 30 days after the actual recovery of the waste and within 1 year after receiving the shipment. This certificate will be contained in or annexed to the movement document. Copies of the signed movement document will be send to the notifier and all concerned competent authorities.                      Copies of all documents have to be saved for three years.</p>		