

An investigation of the risks related to aluminium procurement and the available risk mitigation strategies

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Mémoire de stage

An investigation of the risks related to aluminium procurement and the available risk mitigation strategies

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Abstract

The accentuation of global sourcing put the procurement department even more in a position of risk manager, impacting directly the company financial results. This risk management role is particularly present for the raw materials sourcing, because of the increasing tensions around non-renewable materials.

In this research, the aluminium procurement risks will be emphasised, along side with other raw materials when appropriate, in order to highlight relevant risks mitigation strategies.

The research begins with a literature review of already published data on the subject, as well as the functioning of the aluminium procurement market. Then, the field results part will present the results of the interviews conducted, defining the mentioned risks related with the aluminium procurement and the strategies deployed. Finally, the proposed recommendations to WestRock will be explained in the last sub-section.

Key words

Aluminium – procurement - raw materials - risk – mitigation – strategies

Résumé

L’accentuation des achats à l’international a permis au département achats d’avoir une position accentuée en tant que manager du risque, en impactant directement les résultats financiers de l’entreprise. Cette position de “risk manager” est particulièrement présent pour les achats de matières premières, notamment à cause des tensions croissants autour des matières premières non-renouvelables.

Dans cette recherché, les risques lies à l’achat d’aluminium seront mis en avant, en même temps que les risques lies à d’autres matières premières lorsqu’il sera approprié de le faire. Cela aura pour but de mettre en avant les stratégies de gestion et atténuation des risques.

Cette recherché débutera avec une revue de littérature, avec les données déjà publiées sur le sujet, ainsi que le fonctionnement du marché de l’achat d’aluminium. Ensuite, les résultats de l’enquête terrain seront présentés, avec les résultats des interviews menées, définissant les risques inhérents à l’achat d’aluminium ainsi que les stratégies mis en place pour atténuer ces risques. Enfin, les recommandations proposées pour l’entreprise WestRock seront présentées.

Mots clefs

Aluminium – achats – matières premières – risques – atténuation - stratégies

TABLE OF CONTENTS

AVERTISSEMENTS **2**

ACKNOWLEDGMENTS **3**

ABSTRACT **4**

RÉSUMÉ **5**

APPENDICES **10**

LIST OF FIGURES **11**

LIST OF TABLES **12**

INTRODUCTION **13**

PART 1: LITERATURE REVIEW **16**

1. Supply risk management overview **17**

1.1. Definitions of the key terms 17

1.1.1 Risk definitions 17

1.1.2 Risk Management 18

1.1.3 Supply Chain definition 19

1.1.4 Supply Chain Risks 19

1.1.5 Criticality and supply risk 21

1.2. Risks driving factors 22

1.2.1 Introduction 22

1.2.2 External factors 23

1.2.3 Internal factors 25

1.3. Risk mitigation: how to handle the supply risks? 26

1.3.1 Introduction 26

1.3.2 Risk management process 27

1.3.2.1 Identify and define the risks 27
1.3.2.2 Prioritize the risks 28
1.3.2.3 Prevent and follow up the risks 29
1.3.3 Strategies to mitigate the risks 30
1.3.3.1 External strategies 31
- Supply disruption risks mitigation strategies 31
1.3.3.1 Internal strategies 32
- Policies 32
- Criticality matrix 33
- Contingency planning 33
- Supplier risk mitigation process 34
1.3.4 Skills required 36

2. Aluminium category: market and procurement 37
2.1 Introduction 37
2.2 The aluminium market 39
2.2.1 Market structure – primary aluminium 39
2.2.2 Aluminium supply chain 40
2.2.3 Main players 41
2.3 Aluminium procurement 43
2.3.1 Aluminium price 43
2.3.1.1 London Metal Exchange 43
2.3.1.2 Other price components 44
2.3.1.3 Prices volatility 45
2.3.2 Aluminium supply situation 46
2.3.2.1 Raw materials supply situation 46
2.3.2.2 China impact on raw materials supply 46
2.3.2.2 Aluminium metal supply risks 47
2.3.3 Aluminium risk mitigation strategies 48
2.3.3.1 Supply chain decisions 48
2.3.3.2 Information sharing 48
2.3.3.3 Hedging strategies 49

PART 2: FIELD RESEARCH 51

1. Research methodology 51
1.1 Secondary research 51

1.2 Primary research 52

2. Field research results 53

2.1 Aluminium procurement structure 53

2.1.1 Supply chains organizations 53

2.1.2 Procurement organizations 55

2.2 Aluminium stakes and risks 57

2.2.1 Financial risks 57

2.2.1.1 Prices volatility 57

2.2.1.2 The LME and Premiums impacts 58

2.2.1.3 Exchange rates 59

2.2.2 Supply chain risks 60

2.2.2.1 Supply disruptions 60

2.2.2.2 Supply chain efficiency 61

2.2.3 Supplier failure risks 61

2.2.3.1 Profitability 61

2.2.3.2 Quality 62

2.2.4 Market risks 62

2.2.4.1 Availability 62

2.2.4.2 Geopolitical risks 63

2.3 Risk mitigation strategies 64

2.3.1 Hedging strategies 64

2.3.2 Contractual strategies 67

2.3.2.1 Contract clauses 67

2.3.2.2 Supplier relationship management 68

2.3.2.3 Review the need 70

2.3.3 Internal tools 70

2.3.3.1 Committees 70

2.3.3.2 Electronic systems 71

2.3.3.3 Other tools 72

3. Aluminium procurement: recommendations to WestRock 73

3.1 Introduction 73

3.2 Recommendations timeline 76

3.3.1 Short-term strategies 76

3.3.1.1 Contracts implementation 76

3.3.1.2 Supplier classifications 77

3.3.1.3 Supply chain mapping 78
3.3.1.4 RMI tool 78
3.3.1.5 Risk management committees 79
3.3.1.5 Risk management policy 80
3.3.2 Medium-term strategies 81
3.3.2.1 Short-term strategy implementation 81
3.3.2.2 Multi currency invoicing 81
3.3.2.3 Supplier risk information availability 82
3.3.3 Long-term strategies 83
3.3.3.1 Volumes consolidations – mass purchasing 84
3.3.3.2 RMI tool spread – volume forecasts 85

CONCLUSION 87

BIBLIOGRAPHY 89

APPENDICES 94

Appendix 1 - Classifications of risks, created from Lockamy et al (2010) and Kumar et al (2010) 95
Appendix 2 - Disruption and operational risks, created from Guertler and Spinler (2015) 96
Appendix 3 - Risk prevention, by Tréhan (2014) 97
Appendix 4 - Criticality matrix, in Gloser et al. (2015) 98
Appendix 5 - Identify critical suppliers, by Carter et al. (2010) 99
Appendix 6 – Aluminium consumption in 2002, from Mouak (2010) 100
Appendix 7 - Aluminium supply chain, adapted from Egloff (2013) 101
Appendix 8 - LME price graph - 3 months Buyer - 2014 2015 102
Appendix 9 - Sampling – companies supply chains 103
Appendix 10 – Interviews results summary (1) 104
Appendix 10 – Interviews results summary (2) 105
Appendix 10 – Interviews results summary (3) 106
Appendix 11: Recommended strategies: short-term, medium-term, long-term 107
Appendix 12 - Procurement process and risk mitigation strategies - Metal Parts 108
Appendix 13 – WestRock current risk matrix 109
Appendix 14 – Déclaration anti-plagiat - diffusion 110

Appendices

Appendix 1 - Classifications of risks, created from Lockamy et al (2010) and Kumar et al (2010)

Appendix 2 - Disruption and operational risks, created from Guertler and Spinler (2015)

Appendix 3 - Risk prevention, by Tréhan (2014)

Appendix 4 - Criticality matrix, in Gloser et al. (2015)

Appendix 5 - Identify critical suppliers, by Carter et al. (2010)

Appendix 6 – Aluminium consumption in 2002, from Mouak (2010)

Appendix 7 - Aluminium supply chain, adapted from Egloff (2013)

Appendix 8 - LME price graph - 3 months Buyer - 2014 2015

Appendix 9 - Sampling – companies supply chains

Appendix 10 – Interviews results summary

Appendix 11 – Recommended strategies: short-term, medium-term, long-term

Appendix 12 - Procurement process and risk mitigation strategies - Metal Parts

Appendix 13 – WestRock current risk matrix

Appendix 14 – Déclaration anti-plagiat - diffusion

List of figures

Figure 1 - Four dimensions of supply chain risks (from Guertler and Spinler, 2015)

Figure 2 - Risk management and assessment (ENISA), from David (2011)

Figure 3 - Types of strategies by Mintzberg (1978)

Figure 4 - Supplier risk management process, from Carter et al. (2010)

Figure 5 - Suppliers screens by Carter et al. (2010)

Figure 6 - Aluminium process (Our value chain, 2015)

Figure 7 - Strategic groups - primary aluminium market - adapted from Mouak (2010), MarketLine (2015)

Figure 8 - Novelis cost breakdown, adapted from Madden (2014)

Figure 9 - Company C procurement 4 dimensions

Figure 10 - Procurement consolidation, company C example

Figure 11 - WestRock metal parts suppliers tier 1 and 2

List of tables

Table 1 - Factors driving supply risks (Kumar and Babiceanu, 2010 and Aqlan and Lam, 2015) crossed theories

Table 2 - Costs split of producing aluminium (Mouak, 2010)

Table 3 - Ranking of aluminium producers 2014. From Draper (2015)

Table 4 - Respondents List - Primary research

Table 5 - Respondents risk mitigation strategies

Table 6 - Metal parts risks levels, WestRock EMEA

Introduction

Over the previous decades, the globalisation process encouraged global sourcing, dramatically increasing the risks and complexities of the supply chains. The procurement department role also shifted from a cost-impacting role to a strategic one for the company. Beyond ensuring the availability of the products and services, the procurement function is more and more put forward as a value creator, a cost manager as well as a risk manager.

This risk manager role enables the sourcing function to directly impact on the financial results reassurance as well as the global company performance. Nonetheless, facing growing international procurement-related risks, all the procurement departments do not succeed to mitigate the risks correctly. In fact, taking the example of the raw materials markets, important risks are arising facing the availability of non-renewable resources, supply disruptions, geographical tensions and exchange rates impact.

In this research, we are taking the example of the raw materials risks, and more particularly the aluminium procurement. In fact, very little research has been published concerning aluminium, and the raw materials procurement research field would gain to be improved with deeper procurement risk mitigation strategies researches. With a growing use in the industries, the researcher has notably chosen to focus on this raw material for the following reasons:

“Aluminium is one of the youngest industrial metals. Due to properties such as light weight, high corrosion resistance, good formability, and non-toxicity, it has been the fastest-growing metallic material in the past 100 years. With a global primary metal use of 27.4 million tonnes and a recycled aluminium production from purchased and tolled scrap of approximately 13.1 million tonnes (…) in 2003, it has taken the top position of all the non-ferrous metals” (Boin & Bertram, 2005).

Taking into consideration the previous arguments, the resulting questions would be: **Aluminium procurement: what are the risks and how to mitigate them?**

This problematic will be particularly applied to the chosen company, WestRock, and its Home, Health and Beauty (HH&B) business unit. The company was formed in July 2015 with the merger of two American companies: Medwestvaco (MWV) and Rocktenn. Operating in the packaging industry, the company is split between the paper and plastic packaging business units. The company employs 42 000 people worldwide, and has 275 facilities or business locations in 30 countries. In company European headquarter, where the sourcing team is located, is dealing with the European plants procurement, but also some projects in collaboration with the Chinese counterparts as well as the Brazilians ones.

In the Home Health and Beauty business unit are produced dispensers, pumps, sprayers and dispensing closures for various industries. Concerning the application of aluminium in this type of products, WestRock is buying what we call “metal parts”, notably for the perfumes actuators. Along with the resin, the metal parts are the most important raw material spends.

WestRock’s metal parts suppliers are buying aluminium foils and then transform the foils into the desired metal part. The European plants for the HH&B business units are in Spain, Italy and Germany. In this decentralized organization, the local teams are placing the purchase orders for the metal parts purchase, while the global contracts are negotiated in Geneva for all the plants.

For this category, risks have been identified, such as supplier financial health, supply disruptions or quality. Nonetheless, the main issue is that there is few effective risk mitigation strategies put in place in EMEA as well as globally. The strategies are not formalized and gain to be extended to impact the risks. As the company is only partially answering to the aluminium risks issue, the discussed problematic is particularly relevant for WestRock.

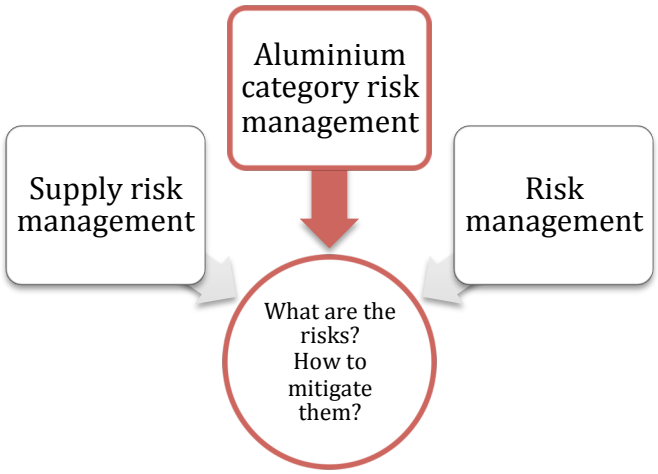
In order to answer to the problematic, this work is divided in two main parts:

The first part aims to introduce the literature already published in the procurement risk management field. From the risk management general approach, the analysis will bring us to focus on the supply risk management and further down to the aluminium category risk management. This part will allow us to fully understand the aluminium market functioning, in order to comprehend the related risks.

The second part, the field research, will explain the primary research effectuated as well as the recommendations to WestRock. The interviewees' answers concerning the existing aluminium procurement risks and the applicable risk mitigation strategies will be discussed. Then, the recommendations sub-section will aim to provide solid tools and applicable systems to WestRock EMEA raw material team to reduce the identified and potential unrecognized risks.

Part 1: Literature Review

This first part of this research aims to provide a theoretical approach to the aluminium risk management, firstly at a broader sense with the risk management theory and then focalised on the aluminium category. The research is, in fact, following a funnel-shaped logic:



In the first section of this literature review, we will discuss the overall risk management with some key definitions, and then explain the main risks driving factors and finally the risks mitigation strategies put in place to face risks consequences. In the second section, we will focus on the aluminium category and the risks related to the market structure and the current supply market.

This first part will allow us to better understand the need for the purchasing department to mitigate the risks inherent in the purchase of aluminium. Also, this theoretical data will provide us with the current state of the art, concerning the risk mitigation strategies.

1. Supply risk management overview

1.1. Definitions of the key terms

This first subsection will allow us to better understand the critical terms and definitions around the notion of risk.

As “risk is a concept that has application in everything we do” (Lockamy, 2010), we will focus on risk occurring in the business environment, and then more precisely on the risks linked with the aluminium procurement.

1.1.1 Risk definitions

Throughout the literature, various definitions of risk can be found. In fact, according to Heckmann *et al* (2015), “the term risk is still vague and often ill-defined”.

In fact, whereas the International Standard Organization (2009, in Gloser *et al*, 2015) defines risk as “the product of probability of occurrence of a specific scenario and the consequences caused by this scenario”, Spekman and Davis (in Guertler, 2015), “define risk as the probability of variance in an expected outcome”. In addition, we can cite Aqlan *et al* (2015), saying that “a risk has three components: the risk event, its probability of occurrence, and its impact”.

The definition of risk chosen for this study is summarized below:

> “Risk = probability of occurrence x consequence
> = likelihood x vulnerability
> = relative frequency x severity” (Gloser, 2015)

In addition to risk definitions, it seems useful to have an overview of the different risks classifications that we can find in the business-oriented literature. Kumar et al (2010) classifies the demand, production and distribution risk, the supply and finally the interaction risk. Looking at Appendix 1, we can note that for this author, the risks are present at each step of the supply chain, beginning with the demand forecast and

finishing with the interactions in the supply chain environment. Lockamy et al (2010) had a different approach towards the various risks types, focusing on operational, network related and external risks. We can note that Lockamy et al (2010) put an entire category for “external forces risks”, whereas Kumar et al seem not to include them in their classification.

Furthermore, in the context of raw material risks, Achzet & Helbig (2013), distinguish three categories: “supply risks, vulnerability and ecological risks”.

Beyond these definitions and classifications, it is critical to understand what is the risk management.

1.1.2 Risk Management

Firstly, Sherman et al (2014), remind us that: “as the risks businesses face have changed and become more globalized, the role of risk management and its structure within the organization has evolved too”. In fact, they explain that the “ERM (Enterprise risk management)” is at the centre of the companies, and that the risk management changed “from primarily defensive to increasingly offensive and strategic” (Liebenberg & Hoyt, 2003, in ibid).

Linked with the risk definitions seen above, Merna and Al-Thani (2005, in Aqlan *et al*, 2015), define the risk management as “identify risks specific to an organization and to respond to them in an appropriate way”. Completing this previous definition, Brode (2015), argues that it is also about “limiting possible future losses according to a firm’s risk appetite”. Beyond that, it seems important to add Kumar et al (2010) statement, which is that risk management is also “measuring (and) (…) making decisions explicitly to minimise their undesired effect”.

The risk management in companies is put in place in every department, at different levels. In this research, we are focusing on the Supply Chain, with its own risks, as defined below.

1.1.3 Supply Chain definition

First of all, we can define the supply chain as “a network of multiple businesses and relationships (…) (including) all companies/ organizations with whom the focal company interacts directly or indirectly through its suppliers or customers, from point of origin to point of consumption“ (Lambert & Cooper, 2000).

Nowadays, “global supply chains are vulnerable towards different types of risks and are dynamically expanding with the increase in globalisation” (Kumar & Babiceanu, 2010). Towards the same idea, Kumar & Babiceanu (2010), explain that with several “tiers of suppliers (…) numerous risks at different levels” happen. In fact, this global trend can put at risk the first goal of supply management, which “is to secure uninterrupted flows of direct materials from the supply base” (Kraljic, 1983, in Ellis et al, 2010).

Knowing the above emerging major issues, it seems important for us to understand exactly what is meant by Supply Chain risks and all the risks that composed it.

1.1.4 Supply Chain Risks

Kumar & Babiceanu (2010) explain that: “risk in supply chains can be defined as the potential deviations from the initial overall objective that, consequently, trigger the decrease of value-added activities at different levels”, whereas Heckmann et al (2015) mention the “loss (…) in terms of (…) target value of efficiency and effectiveness described by uncertain developments (…) whose changes were caused by the occurrence of triggering-events”. The events mentioned by Heckmann et al. (2015) can provoke what Ellis et al. (2010) are calling “supply disruptions” and the losses attributable to the disruption. Furthermore, Carter et al. (2010) add that “risk management is predicated on having sourcing plans in place (…). Negative events are those that disrupt the sourcing plans.”

To be more precise in the Supply Chain risk definition, Guertler & Spinler (2015) have found four dimensions comprised in this risk, showed in figure 1.



Figure 1 Four dimensions of supply chain risks (from Guertler and Spinler, 2015)

More precisely and more Supply Chain focused than Kumar et al (2010), Guertler & Spinler (2015) provide us with four dimensions of the Supply Chain risks: supply, demand, process and product risks. Suttner (2005, in Lockamy & McCormack, 2010) also refers to demand-side risks as well as Wagner and Bode (2006, in Lockamy & McCormack, 2010) who are referring to supply-side risks.

The supply risk is more precisely defined "as the probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety" by Zsidisin et al. (2005, in Lockamy & McCormack, 2010).

Going more deeply into the supply risks, Guertler & Spinler (2015) also argues that two types of supply risks exist: the disruption risk, which comes from unplanned and unanticipated events and leads to a cut off of supply, and the operational risk, coming from recurrent supply uncertainty. The Appendix 2 summarizes their statements.

Furthermore, Nooraie & Mellat Parast (2015) added that Supply Chain visibility is linked to Supply Chain risks: "the central question (…) is how to choose suppliers in order to

minimize the supply risk and how to enhance visibility without exceeding the production or total budgets".

As we have understood what the risks present through the Supply Chain are, authors are trying to provide a definition of these risks management. For instance, Neiger et al. (2009, in Lockamy & McCormack, 2010) have introduced the "supply chain risk management (SCRM)", which is, according to them, "a field of growing importance (…) aimed at developing approaches for the identification, assessment, analysis and treatment of areas of vulnerability and risk in supply chains". As a part of the SCRM, Knoeri et al. (2013) add a time perspective to the risk evaluation: "the supply risk is evaluated on the short term by the fragility of the existing market (…); on the long term, by considering (…) environmental and social, political, and economic availability".

1.1.5 Criticality and supply risk

Gloser et al. (2015) explain that supply risks and criticality "may (both) be assessed for an enterprise (e.g. Duclos et al.,2008), a country (e.g. Erdmann et al.,2011), a region (e.g. European Commission,2010,2014) or for the world (e.g. Graedel and Nassar, 2013)". Nonetheless, as other authors, they are using the word "criticality" more specifically for raw materials. In fact, Achzet & Helbig (2013) explain that this word is used since 1939 within the material context.

To cite the European Commission (in Gloser et al., 2015): "To qualify as critical, a raw material must face high risks with regard to access to it, i.e. high supply risks or high environmental risks, and be of high economic importance. In such a case, the likelihood that impediments to access occur is relatively high and impacts for the whole EU economy would be relatively significant."

To summarize their theory, Gloser et al. (2015) give the following formula to determine the raw material criticality:

"Raw material criticality
= supply risk x vulnerability
= likelihood of supply disruptions x economic consequences" (Gloser et al., 2015)

In addition, they explain that within a raw material criticality matrix, "a measure of criticality level can be assigned to each raw material": this can be the start of mitigation strategies (see section 3).

1.2. Risks driving factors

1.2.1 Introduction

We have seen that "supply disruptions may have immediate or delayed negative effects on buying firm performance over the short and/ or long-term" (Sheffi and Rice, 2005 in Ellis et al., 2010) and "affect the entire chain" (Guertler & Spinler 2015). As a consequence, in this subsection we will have look at the factors that drives supply risks.

In order to do that comprehensively, several authors are splitting the factors between internal and external point of view. The summary is to be found in table 1.

Whereas Kumar & Babiceanu (2010) defend "the internal operational risk factors" versus the "external operational risk" factors, Aqlan & Lam (2015) explain that uncertainties, creating the risk, come both from inside ("endogenous uncertainty") and outside the company ("exogenous uncertainty").

Endogenous uncertainties	Exogenous uncertainty
In the company	Outside the company
Mitigated with managerial response	Beyond managerial control
=> Internal Factors	***=> External Factors***

Table 1 Factors driving supply risks (Kumar and Babiceanu, 2010 and Aqlan and Lam, 2015) crossed theories

To organize this subsection, we will look at this split, explaining first the external factors that create supply risks and in the second part the internal ones.

1.2.2 External factors

As every part of the supply is interrelated, each external phenomenon throughout the chain will impact the entire process (Guertler & Spinler, 2015).

Firstly, Achzet & Helbig (2013), argue that the company concentration, especially in the raw materials market, is used as a risk indicator to determine the level of supply risk. Following the same idea, Moss et al. (2013) argue that “the cross-country concentration of supply, which refers to risks emanating from the structure of supply (monopolistic or dominated by only a few players)” is a supply risk factor as well.

From the study of several supply risk assessment processes, Achzet, & Helbig (2013, from Rosenau-Tornowetal, 2009) also noticed that: “the stock keeping of resources (…) can have a strong influence on the supply and demand elasticity of resources”.

Besides the above factors, Ellis et al. (2010) highlighted two main external supply environment factors creating risks, and therefore disruptions. The first factor described is the technological uncertainty, which can be defined as “the rate of change in underlying technologies of a purchased product” (Stump et al., 2002 in ibid). This uncertainty makes the forecasts harder as “new opportunities and threats arise” (Bensaou and Anderson, 1999; Cannon and Perreault, 1999, in ibid). At the same time, it seems useful

to mention that as the demand is changing, the supplier may not have the capacity to cover it; Moss et al. (2013) mentioned that as a supply risk factor.

The second element demonstrated by Ellis et al. (2010), is the market thinness, defined by Cannon and Perreault (1999, in ibid) as ‘‘the degree to which a buying firm has [a limited number of] alternative sources of supply to meet a need’’. The thinner the market is, fewer suppliers available can be found because “few suppliers sell comparable goods” (ibid). This factor raises the issue of supplier dependence, where “suppliers have greater power because the resources they supply cannot be obtained from other sources” (ibid). This inability to switch suppliers increases the supply risk: “this inability to acquire needed resources from alternate suppliers means that sourcing organizations will bear the full brunt of the costs associated with the disruption” (ibid).

Nonetheless, Ellis et al. (2010) are underlining the fact that the market thinness is not always market imposed: “buyers create self-imposed thin supply markets by purchasing customized direct materials that require suppliers’ specialized investment”. To conclude this argument, the authors argue that supply disruption risk and market thinness are supported by two mechanisms: supplier “lock in and reduced information flow”. Supporting Ellis et al. idea concerning the supplier locked in, Kraljic (1983), explained that, like the “extent of contractual coverage, regional spread of supply sources, and availability of scarce materials”, the “vendor mix” is a critical determining factor of supply risk.

Furthermore, the “regional spread of supply sources” described by Kraljic brings us to mention the geopolitical risk (Munoz et al. 2015). In fact, as they argue, “the geopolitical situation is hardly stationary” and impossible to predict: this is a risk to take into account when buying globally. Moss et al. (2013) have also alluded to “the political risk (…), which refers to risks caused by a broader political instability or internal conflicts in a major supplying country.” They underline that this risk “can have significant impact on global production capacity, including the likelihood that individual suppliers will seek to restrict access”.

In conclusion of the external risks argumentation and towards the internal factors, we can quote Kraljic (1983) who explained that: “The greater the uncertainty of supplier relationships, technological develoments, and/or physical availability of those items, the more important management becomes“.

1.2.3 Internal factors

Not only external factors can drive supply risks: internal strategies, decisions or perceptions can lead to a greater level of risk, as explained below.

Firstly, we can cite the company strategies can be to blame for a higher level of supply risk.

From the purchasing side, Dyer and Singh (1998, in Ellis et al. 2010) are explaining that: “firms often seek to reduce uncertainty by establishing tighter relationships with suppliers“. This increases their dependence to their supplier, “thus, the difficulty of switching suppliers which increases the impact of those disruptions“. Furthermore, Monczka et al. (2001, in Gelderman & Semeijn, 2006) argue that the “increased level of outsourcing is a prevailing trend”: “defined as the shifting of work done ‘in-house’ to another company” (Lockamy & McCormack, 2010). They identified the outsourcing decision as a risk-driving factor, linked to the supplier dependence in case of supply disruption. At the same time, Aqlan & Lam (2015) support the idea that the lean management “trend (…) will exacerbate the risk exposure of supply chain agents”. According to them, this strategy “leads to an increased dependency between supply chain partners” because the inventories are kept low through the value chain. Carter al. (2010) are also supporting this statement: “while outsourcing is justified on the basis of lower costs, it results in a loss of control over the manufacturing (…) process”. On the other hand, we can evoke the company overall strategy which can often be a factor of supply risks. In fact, among the external risks factors cited by Ellis et al. (2010) two internal remain: “item importance” and “item customization”. The first is defined as “the degree to which a purchased part is critical to the manufacture of an organization’s other parts, components, or end-products” (ibid). The importance of the item influences the supply risk level because it “increases an organization’s vulnerability if acquisition of

the resource is no longer assured. From the risk based perspective, a buying firm experiences more significant losses from a supply disruption for critical items" (ibid). On the other hand, "item customization (is) the extent to which purchased items are modified according to the specifications of a specific buyer" (ibid). The risk arises because "buyers have little immediate control over supply market thinness" (ibid) even if they are making investments in their suppliers.

On a bigger scale, Knoeri et al. (2013) explain that the internal decisions of "large international companies might induce changes in the supply chain (…) and therefore affect the raw materials' criticality" and risks due to interdependencies.

Last but not least, it seems interesting to mention the risk perception by the buyers, as it will impact the risk mitigation strategies. Ellis et al. (2010) support the same idea: the "overall risk appraisals play an important role in determining behaviour. Shapira (1995) supports this notion by suggesting that executives base decisions on a ''feel'' of overall risk". Furthermore, Ellis et al. (2010) conclude: the "overall supply disruption risk assessments are driven by buyers' judgments of the magnitude and probability of supply disruption they are facing".

Risk perception drives risk assessment: in fact, the above individual's perceptions determine the risk evaluation level (measure) and can therefore be a risk driver if the individual perception is not accurate.

1.3. Risk mitigation: how to handle the supply risks?

1.3.1 Introduction

During the last decade, companies have become more aware "of how detrimental risk can be to a business" (Elzarka, 2013, Hüneretal, 2014, in Nooraie & Mellat Parast, 2015). The purchasing function, now recognized as a strategic one (Knight et al., 2014), handles various risks throughout the supply chain.

Following the idea, we have explored in the previous subsections the various definitions needed around the supply chain risk management and then underlined the main reasons behind the supply risks.

In this subsection, we aim to demonstrate that in the current literature, authors and studies have published researches with the aim of providing at the bases for risk mitigation. According to the Oxford dictionary, mitigation is “The action of reducing the severity, seriousness, or painfulness of something” (Oxford dictionary, n.d).

Firstly, following the ENISA framework illustrated in figure 2, as well as Bachelet researches (in Tréhan, 2014), we will follow the steps starting by identifying the risks, prioritizing them, preventing them and finally following up the potential risks. Secondly, we are going to explore the strategies present in the literature. Finally, it seems important to mention the skills required in the purchasing teams to put accurate risk mitigation plans in place.

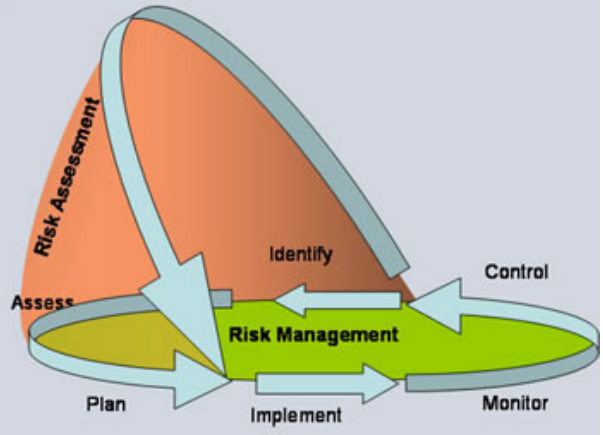


Figure 2 Risk management and assessment (ENISA), from David (2011)

1.3.2 Risk management process

1.3.2.1 Identify and define the risks

The first step towards mitigating the risks is to identify the potential risks in the supply chain. As stated by Neigeretal (2009, in Aqlan & Lam, 2015), “risk identification is a

critical step for the success of supply chain risk management". Supply chain risks are in fact to be considered at a global level: Snell (2015) argues that: "having visibility and strong supplier relationships at the first tier of the supply chain is clearly no longer enough". A study from the CIPS (Snell, 2015) maintain this idea saying that supply chain managers having "strong relationships with vendors up to tier three and beyond, 67 per cent said they had avoided a major supply chain crisis in the past 12 months".

Identifying supply risks beyond tier 1 and analyse the associated risks became mandatory for a firm to keep its "ability to generate revenue" (Lockamy & McCormack, 2010).

1.3.2.2 Prioritize the risks

After having identified the risks we are looking at, the next step is to understand which risks can be handled, and therefore how to measure them throughout the chain. In fact, Banchelet (in Tréhan, 2014) argue that we cannot handle all the supplier risks, that we should evaluate "the risk event status (amount of stake x risk probability)".

Why measure the risks? Heckmann et al. (2015) argue that: "in order to assess and compare different solutions that aim to limit the extent of risk, decision-makers need to (somehow) quantify risk". They also argue that there is a "lack of a clear and adequate quantitative measure for supply chain risk (respecting) the characteristics of modern supply chains" (ibid).

Nonetheless, Moss et al. (2013) demonstrate that "most of the studies combine measures of 'supply risk' with an assessment of 'economic importance' and then combine both indicators to an overall criticality assessment". Mentioning indicators, Achzet & Helbig (2013) explain that the "starting point to evaluate raw material risks" is to select indicators: "among the indicators, country risk, country production concentration, static reach and the by-product dependency were considered by the studies the most" (ibid). Ellis et al. (2010) also argue in favour of setting indicators to "measure and evaluate risks". Towards that, Guertler & Spinler (2015) point out that

suppliers should be evaluated, beyond “price competitiveness (…) in terms of potential product failure, bankruptcy, or even political risk”.

Concerning the raw materials supply risks, Knoeri et al. (2013) argue that: “the impact of a supply restriction is evaluated by considering the difficulty of substituting a restricted material, where the consequences (i.e. economic costs) depend on the particular form of restriction (e.g. physical availability, technical and economic feasibility).”

To go more deeply into the risk measurement, Lockamy & McCormack (2010) have introduced a methodology: “The PRAM (Procurement Risk Assessment and Mitigation) methodology, developed by the Dow Chemical Company to measure SC risk and its impact. This approach examines (…) the following factors of a supply chain: supply market risk, supplier risk, organisation risk, and supply strategy risk (Hackett Group 2007)”.
Furthermore, Hoyt & Liebenberg (2011, in Sherman, M. et al. 2014) argue in favour of “integrated, enterprise-wide data on risk”. On the other hand, Heckmann et al. (2015) mention several methods applicable to measure the risks: “Standard deviation, mean-variance approaches, value-at-risk, conditional-value-at-risk or premiums”.

Nonetheless, measuring risk is also measuring the financial impact that disruption may have on the chain. Lockamy & McCormack (2010) explain that “although the true costs of any supply chain disruption can be difficult to quantify precisely, at least one firm surveyed by Rice and Caniato (2003) estimated that the daily cost impact of a disruption in its supply network to be in the neighbourhood of $50–$100 million”.

1.3.2.3 Prevent and follow up the risks

Bachelet (in Tréhan, 2014) argue that in order to prevent the supplier risk, companies have to put in place “mitigation plans”. To mitigate the risks, procurement services can either decrease the amount of stake (protect the business) or decrease the risk probability (prevention) (ibid). The aim is not to have any risk, but rather to have an acceptable risk (Tréhan, 2014). Nonetheless, it seems critical to mention that a manager

should be responsible of the risk prevention. The manager will have the choice between the mentioned choices in Appendix 3 (avoid the risk, change the occurrence, change the consequences, share or retain the risk).

The final step of the framework is about following up the risks regularly, in order to assess the evolution and potential market changes that will influence the level of risk initially identified. In fact, a risk and technological monitoring is critical (Tréhan, 2014).

Having taken into account the previous arguments to measure, prioritize, prevent and follow up the supplier risks both in the financial and concerning the risk extend, it seems critical to review the strategies that businesses can put in place to mitigate the supply risks.

1.3.3 Strategies to mitigate the risks

First of all, it seems critical to keep in mind that strategies are defined as “deliberate plans conceived in advance of the making of specific decisions“ (Mintzberg, 1978). To define more concretely what can be a strategy, he defines the strategy types as defined below and in figure 3:

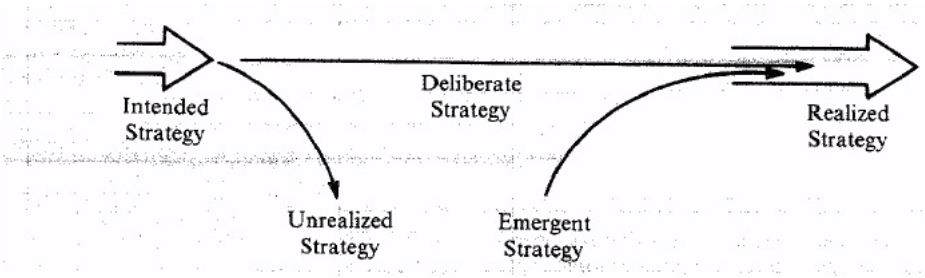


Figure 3 Types of strategies by Mintzberg (1978)

“(1) Intended strategies that get realized; these may be called deliberate strategies” (ibid)

“(2) Intended strategies that do not get realized, perhaps because of unrealistic expectations, misjudgements about the environment, or changes in either during implementation; these may be called unrealized strategies” (ibid)

“(3) Realized strategies that were never intended, perhaps because no strategy was intended at the outset or perhaps because, as in (2), those that were got displaced along the way; these may be called emergent strategies.” (ibid)

Knowing that every strategy can turn out to be unrealized, and with a more and more unpredictable environment and supply chain complexity increasing (Heckmann, 2015), companies “should be able to identify, measure, and prioritize the different risks in the supply chain, develop proper mitigation strategies, and monitor and control these risks” (Aqlan & Lam, 2015). For this, companies should be creative, because “traditional risk management” can fail without considering the current dependencies in the supply chain (ibid).

To demonstrate the risk mitigation strategies, we are going to firstly explain the external strategies available first, and then the internal ones.

1.3.3.1 External strategies

- Supply disruption risks mitigation strategies

Concerning the strategies companies can put in place towards the external environment, we can firstly evoke Kraljic’s (1983, in Ellis et al. 2010) argument, which is “searching for and developing alternate sources of supply, to mitigate the risks associated with supply disruption”. Heckmann et al. (2015) share this point of view, advising that it can be done “before or while changes to their supply chain and its environment occur”. Besides, Ellis et al. (2010) explain that the choice of this strategy should be done after “an assessment of overall supply disruption risk given the situation associated with the incumbent supplier”. They add to this point that in order “to mitigate external sources of supply disruption risk such as market thinness and technological uncertainty”, investment “in new supplier development and joint product development capabilities”

(ibid) can be a strategy to be put in place within a company. Krause (1999, ibid) share this idea.

Furthermore, Ellis et al (2010) argue for "suppliers' investments in flexible manufacturing, back-up systems, and spare capacity" to reduce the supply risks. Tréhan (2014) also insist on the fact that the best way to reduce the supply risks is to maintain the interdependence with the supplier.

We can conclude by quoting authors cited by Ellis et al (2010) about strategies to be set up in order to reduce risk exposure: the "use of early supplier involvement practices (Petersen et al., 2005), (…) and integration of logistical transportation and information systems (Kaynak and Hartley, 2006)".

1.3.3.1 Internal strategies

Besides external strategies, businesses, through procurement departments, can put in place internal strategies to mitigate the supply risks.

- Policies

First of all, Ellis et al. (2010) argue that: "implementing purchasing policies and procedures (…) (will) facilitate buyers' translation of objective supplier performance data into accurate risk assessments". Kumar & Babiceanu (2010) also point out the need for "an effective risk management process", because it "decreases the vulnerability of the supply chain by making it resilient and stable". Carter et al. (2010) also insist on the fact that "effectively managing supplier risk first requires a systematic process to monitor the supply base for potential problems". While Talluri et al (2006, in Ellis et al., 2010) defend that "the adoption of specific supplier selection criteria" will recue the risk exposure, Carter et al (2010) argue that "the focus must be on those suppliers who, by nature of their situation in the supply base (e.g sole sources and providers of key items), could create major problems in the event they experience financial or operational problems that would curtail their ability to supply the buying firm". At the same time, Mol et al. (2004) and (Quintens et al., 2006, in Gelderman & Semeijn, 2006) seem to insist on the

fact that “close cooperation inside the firm between purchasing and other departments is needed to facilitate foreign outsourcing”.

- Criticality matrix

Concerning the tools that can be implemented in the procurement department, Glöser et al. (2015) take the example of a study made by the NRC in 2008: it “aimed to compare the criticality of raw materials (“less critical” vs. “more critical”)”. For that, they the created “a list of critical raw materials” at the European level: this can be applicable in any company to mitigate the supply risks and have a clearer picture of the current raw material situation for instance. Glöser et al. (2015) studied several methods of raw material risk mitigation, concluding that: “the concept of criticality determination within a criticality matrix is a powerful tool to identify and communicate economic vulnerabilities due to insecure raw material supply“. Furthermore, they argue that “the uniform risk levels derived from different combinations of “likelihood and consequence” in the risk matrix (…) can be transferred to uniform criticality levels through different combinations of “supply risk and vulnerability” (…) with contour lines”.

An example of Gloser et al. (2015) criticality matrix can be found in Annex 4. In this criticality matrix, the vulnerability level means the “consequences of supply disruptions” while the supply risks level stands for the “likelihood of supply disruptions” (ibid).

- Contingency planning

Evocating other risk mitigation strategies, Sheffi and Rice, (2005, in Ellis et al. 2010) argue for “contingency planning” strategy. Nonetheless, Mintzberg (1978) warns that it “can be risky because the plans may tend to become actualized, whether needed or not”. Ellis et al. (2010) is also defending the need for “buyer’s investments in in-house manufacturing capabilities, and buyer’s and supplier’s joint investment in the development of relational norms”.

- Supplier risk mitigation process

Last but not least, a research made by Carter et al (2010) provides us a process to follow to mitigate the supplier risk specifically. As summarized in figure 4, the process has several steps.

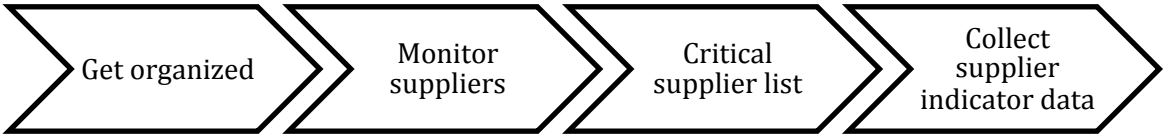


Figure 4 Supplier risk mitigation process, from Carter et al. (2010)

The first step, according to Carter et al (2010) is to "Get organized", first by engaging the "upper management" because "supplier risk management is an organization wide issue". In fact, it "involves additional costs that will impact the budget". Besides, it is important to "assign responsibilities (…) to organize the supplier risk management effort". This will be dne through a "cross-functional team", with a team-leader being designated. The authors insist on the fact that "the finance department should be involved". This team will "organize the effort, analyse the data, generate reports and make recommendations for the risk mitigation efforts".

The second step is to monitor the suppliers, which is "identifying those relatively few suppliers who pose a high risk to the company". For that, the authors are using "a series of screen" (showed in figure 5). From the total base of supplier, the aim is to screen them to finally have only the suppliers that need to be on the "watch list".

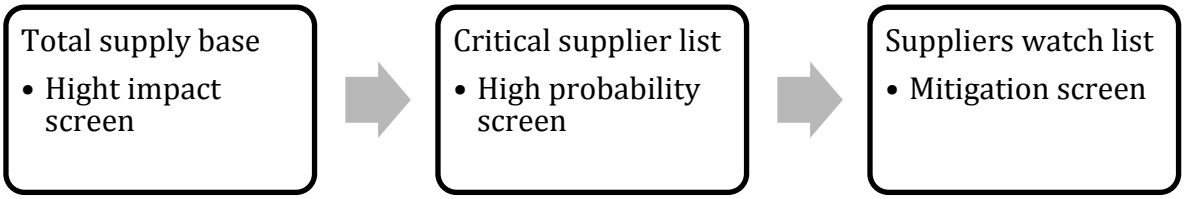


Figure 5 Suppliers screens by Carter et al. (2010)

Carter et al. (2010) add that "the decision to use an outside resource to help screen and monitor the supplier base is one of the most important decisions the risk management team will make".

The third step of the process is presented as "developing critical supplier list". This list will be build according the criteria present in Appendix 5: sourcing strategy applied, and business impact. The suppliers falling into the box "Critical suppliers" are in the critical supplier list. The authors' advice is to update the list "periodically".

The fourth step is about "collecting supplier indicator data", of the firms which are in the previous list. Facing potential issues with getting data from privately owned companies, Carter et al (2010) advice several strategies:

1) Ask the supplier for financial data, and see if they comply

2) Explain to the supplier that the financial data is required to consider a potential business award.

3) "Use a third party", which can be a finance department.

4) "Use non-disclosure agreements" to reassure the supplier about the confidentiality of their data.

Concluding with the advised process, Carter et al (2010) explain that monitoring suppliers beyond the first tier is quite rare: "companies with well organized risk management programs will need to selectively monitor critical suppliers several tiers up the supply chain to look for problems that may cascade down and create a disruption at their first-tier suppliers".

To conclude, having the upper management support and allocated teams, computing resources, solid strategies and tools to mitigate the supply and supplier risks are critical. Nonetheless, skills among the teams mitigating the risks are required in order to carry on with such strategies.

1.3.4 Skills required

As seen in the previous subsections, identify, measure and elaboration of risk mitigation strategies are critical to reduce to supply risks. Nonetheless, some literatures are bringing out the importance of some skills that procurement professionals should have in order to face the cited risks.

Driedonksetal (2010, in Knight et al., 2014) underlines the need for “skills flexibility, on both individual levels and within sourcing teams (…) against supply disruptions” risk. Furthermore, Shao (2011, in Knight et al., 2014) stresses that because “frequent supply disruptions require rapid shifts in sourcing strategies (…) and, potentially, rapid adjustments to purchasing arrangements and redistribution of responsibilities between people and sites”, the agility of people skills are critical, in an “increasingly globalized purchasing environment”.

To these skills, we also can quote Kannan and Tan (2002, cited in Lockamy & McCormack, 2010): “Effective supplier selection, innovative supplier development and meaningful supplier performance assessment have become key competencies needed for success”. Snell (2015) adds that know “who (the) suppliers are” is also critical to mitigate the supply risks and achieve best practices.

2. Aluminium category: market and procurement

During the first section of this literature review, we went through the main points concerning supply risks related definitions, supply risks driving factors and the ways companies can mitigate these risks.

Taking this knowledge as a base for future discussion, this section has a focus on a particular procurement category. This section aims to understand the aluminium metal category, the stakes in place in the market, and the procurement of this metal.

The supply risks linked with this category will be the governing principle in this section, because every argument implies its stake of supply risks.

2.1 Introduction

Before engaging the discussion around the aluminium metal market structure and concerning the procurement of this raw material, it seems interesting for the future discussion about aluminium risk, to explain how is made the aluminium.

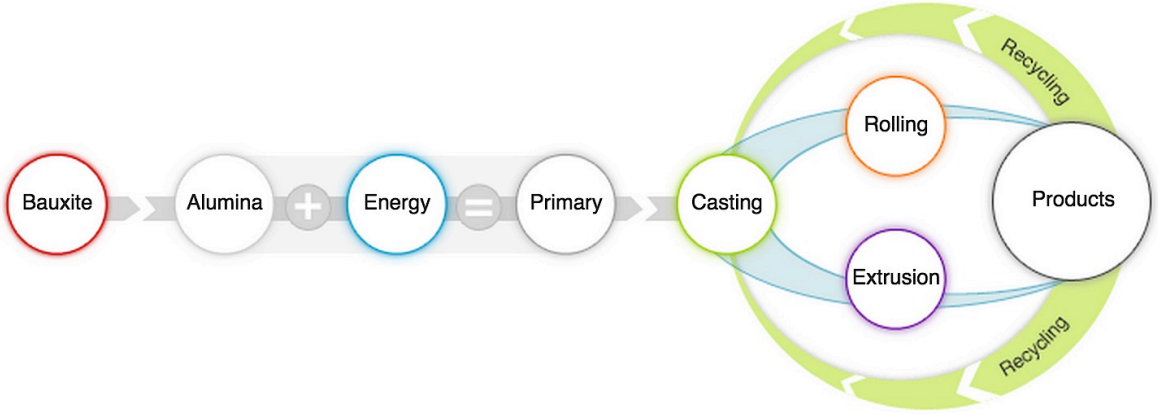


Figure 6 Aluminium process (Our value chain, 2015)

To better understand the value chain of the aluminium, we can took the example of the company Hydro (please refer to 2.2.3), showed in the Figure 6.

The raw material used to produce primary aluminium metal is the bauxite, which will be transformed in alumina (Mouak, 2010). This “is mainly found in a wide belt around the Equator” (Our value chain, 2015). The result of the alumina and a huge amount of electricity is the pure primary aluminium. Hydro (Our Value Chain, 2015) argues “energy accounts for roughly a third of the cost of production of aluminium”, as seen in Table 2.

Energy	30%
Alumina	30%
Labour	15%
Other materials	25%

Table 2 Costs split of producing aluminium (Mouak, 2010)

After the transformation of the primarily aluminium, the aluminium is transformed in partly finished aluminium products. The process starts with the “casting” step. It is about adding “other metals (…) to form various foundry alloys” (ibid). Then two types of processes can be done: rolling (to obtain foils) or extrusion (through tools to obtain tubes for instance). For the foils manufacturers, the primary aluminium remains the main cost driver, before the processing costs and the margin.

Finally, the foils or tubes aluminium are sold to other companies to produce the final product (except if the company is integrated): from the automobile industry to the packaging, this metal has a large base of application. The Appendix 6 is summarizing the main industries.

Concerning the “recycling” process, Mouak (2010), also adds that: “the second source of aluminium is the secondary aluminium, obtained by the recycling of used products”. In Figure 10, we can see that the recycled products can enter the value chain from the casting step, as they “can be recycled indefinitely, without loosing its mechanic features” (Mouak, 2010).

Taking this information into consideration, we are going to have an overview of the aluminium market structure and of the main players in the industry, and then on the procurement of this raw material.

2.2 The aluminium market

In order to understand the dynamics around the aluminium supply risks, it is critical to understand how the market is structured, and the main companies present in the industry.

2.2.1 Market structure – primary aluminium

The MarketLine Industry Profile (2015) firstly explains that the "industry is quite complex, with large sized publicly-traded and state-owned companies operating next to mid-size players". Alongside with this explanation, Mouak (2010) argues that "the industry of aluminium has been showed as example to illustrate oligopoly situation for a long time with the reign of the 6 main companies (…) until the end of the 60s". The author also mentions that this period was the perfect example to demonstrate how "a little group of companies can control an entire industry and impose their prices" (ibid). After this period, Mouk (2010) explains that until the 1980s the "governmental sector" increased, with the impact of having increased "the heterogeneity of the aluminium sector" (ibid). Today, despite a change in the industry, "the level of concentration stayed high, but we can also notice that the portion of biggest companies of the sector increased thanks to (…) mergers and acquisitions" (ibid). The MarketLine Industry Profile (2015) also argue that: "cross -border mergers have been taking place for several years": "deeper consolidation (…) reduces the number of players and increases their sizes". The report also teaches us that the industry is "cyclical and highly affected by macroeconomic conditions, boosting competition (…), rivalry tends to increase." Similarly, Sievers and Tercero (2012, in Glöser et al, 2015) mention that also at the raw material level the market contains "high concentrations of production both on the country and the company level". As concluded by the MarketLine Industry Profile (2015), "rivalry is

assessed as strong" while "the industry experienced contractions in both value and volume terms in 2013".

Facing this type of market structure and prices determined by the London Metal Exchange (see Part 2, sub-section 2), the producers who used to "look for upstream and downstream integration" (Mouak, 2010), now seem to orientate their strategy towards upstream integration, "controlling the sources of supply of bauxite and alumina to master the production costs of the primary aluminium" according to Mouak (2010). Nonetheless, the author insists on the fact that companies still consider downstream integration to "develop the new aluminium applications market."

2.2.2 Aluminium supply chain

All the mentioned above new market dynamics are impacting the supply chain of all the aluminium producers and consumers.

To begin with, Egloff (2013) defends that: "the functioning of the aluminium market is rather atypical". In fact, the author explains that "the finished products manufacturers (…) do not buy directly to the primary aluminium producers (…) but are using intermediaries, who are storing the aluminium in warehouses". A comprehensive chart on the aluminium supply chain can be found in Appendix 7.

The supply chain organization mentioned in Appendix 7 is rising issues notably concerning the time to get the aluminium out of the warehouses: "the aluminium consumers argue for years that the owners of warehouses are preventing them to access the aluminium they need (…). Today 70% of the worldwide aluminium stocks are in warehouses handled with the LME rules" (ibid). In fact, a Marketwatch (2015) article learns us that: "Excessive warehousing of aluminium is a result of this oversupply, with an estimated 5.5 million tonnes currently stored only in London Metal Exchange (LME) ".

Linked to that issue, Madden (2014) explains that: "if a consumer tried to source aluminum today from a Detroit warehouse, it would have to wait until (670 days) to get

the metal“. And because of “a breakdown in the connection between the derivatives market and the physical market and the loss of price convergence through physical delivery has caused two serious risks for the aluminium world: Supply Chain Risk and Wildly Inflated Premiums” (See Part 2, sub-section 2).

2.2.3 Main players

As seen previously, some companies are only producing primary aluminium, and some others are vertically integrated, also producing partly finished products: extruded and/or rolled aluminium. As there is not much information on companies specifically doing extruded or rolled aluminium, we will firstly focus on the primary aluminium producers and then extend to the available information concerning extruded and rolled aluminium producers. Nonetheless, we must keep in mind that the analysis about the market structure remains identical: few players and mostly integrated companies.

As explained by Mouak (2010), the aluminium market is divided between:

- Privately owned companies, highly integrated (1)
- Both privately and publically owned companies, which are in between concerning their integration process. (2)
- Publically owned companies, not very integrated (3)

The figure 7 gives examples of companies that belong to the mentioned categories.

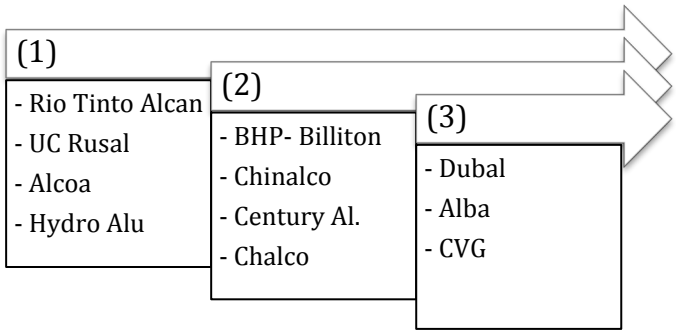


Figure 7 Strategic groups - primary aluminium market - adapted from Mouak (2010), MarketLine (2015)

The world's largest aluminium companies ranked in 2014 are summarized in table 3, the ranking was made according to their "revenue, profit, assets, market capitalization" (Draper, 2015).

2014		
1	ALCOA	USA
2	CHALCO	CHINA
3	HINDALCO (NOVELIS)	INDIA
4	Norsk HYDRO (HYDRO)	NORWAY
5	RUSAL	RUSSIA

Table 3 Ranking of aluminium producers 2014. From Draper (2015)

In this table, we can notice that the main players in 2015 are mostly from developing countries, such as China, India and Russia. Nonetheless, the largest aluminium company in the world is Alcoa, an american company (Draper, 2015). From this ranking, we also can witness the M&A's occurring in the market: the Indian company Hindalco bought Novelis in 2007 (Madden, 2014). Novelis became one of the "world's largest buyer of aluminium (…) (and) world's largest producer of flat rolled aluminium with revenues of $10 billion in its 2014 fiscal year" (ibid). This being said, the majority of the companies in the ranking are privately owned. Besides, we can notice that both Alcoa, Novelis and Hydro are producing extruded aluminium, whereas Rusal remains the major producer of Alumina (Mouak, 2010).

Furthermore, the MarketLine report (2015) is providing figures about the revenues and profitability of Norsk Hydro, Rio Tinto and RUSAL. The figures show that the revenues are high while their profit margin is low, especially since 2013. This raises the risk of supplier failure.

Knowing the above market conditions and main suppliers that could provide primary aluminium, and/or partly finished aluminium, we will now focus on how the procurement of aluminium is organized.

2.3 Aluminium procurement

In this section, the aim is to understand, from a buyer point of view, how the price of aluminium is decomposed and organized, and then to comprehend the supply situations of raw materials and aluminium. In fact, facing the lack of literature about aluminium, we will take a step back to have a look at the raw materials broader category often in this section.

2.3.1 Aluminium price

To begin with, Rosenau-Tornow et al. (2009) remind us that, at the raw materials level, the “prices are subject to economic cycles, also known as ‘‘hogcycles’’. To put it simply: given a sudden increase in demand, the existing supply cannot meet the demand fast enough and prices rise, especially when the demand is inelastic”.

2.3.1.1 London Metal Exchange

Concerning the aluminium market, the London Metal Exchange (LME) determines the prices since 1978 (Mouak, 2010). This change enabled “to shift from a regulation mode by volumes to a price regulation mode” (ibid). Nonetheless, the authors argues that the “prices fluctuations became high, which weakened the companies in this industry”. In fact, the MarketLine Industry Profile (2015) reports that the “rising costs of raw materials squeeze margins” of the manufacturers. The prices variations of the aluminium are, according to Mouak (2010), explained by “less by the shortages or overproduction like main raw materials, but more because of the competitive forces of the industry, the organisational force of the sector and the substitution products role”.
In the LME, aluminium is the main raw material present, along with “two other contracts on plastics also negotiated” (Mouak, 2010). In fact, “the aluminium is, after the petroleum and along with copper, one of the not renewable resources with one of the higher trade value” (ibid).

2.3.1.2 Other price components

Nonetheless, the LME price is not the final price of aluminium. In fact, Madden (2014) explains that: “All purchases of primary aluminium (P1020 and sheet ingot) are priced on a similar basis. The base price includes the LME official price for high grade aluminium (“the LME price”) plus a local market premium (“LMP”), which are published in metal journals”. Along with additional costs, “the purchase prices move almost exactly with changes in the LME price and the LMP” (ibid). Novelis is buying “primary aluminum sheet ingot (…) from primary aluminium producers such as Rio Tinto, Rusal, Emirates Global Aluminium, Hydro Aluminium, and Alcoa on long-term contracts ranging from one to five years” (ibid). Furthermore, Madden (2014) explains that the aluminium costs “pass through” the supply chain, from their suppliers to their clients, to transmit the volatility of the market prices. The cost breakdown presented in Novelis sales contracts is explained below in figure 8. Whereas the “base price” comprises the LME price and the local premiums (Asia, Europe, US Midwest), the second part of the equation is the “conversion premium” (Madden, 2014). This reflect the producer’s ”costs to convert aluminium ingot and scrap into coils plus (the) margin”. In fact, the scrap market has a huge play in the aluminium parts determination: “Scrap is normally priced at a discount to the primary aluminium price to reflect the additional cost of processing and is also influenced by factors specific to the market for scrap” (ibid). Coming back to figure 8, the additional costs are mainly “logistics, alloy, treatment, size and form” (ibid). The sales prices are renewed every month to reflect the shift in the market (ibid).



Figure 8 Novelis cost breakdown, adapted from Madden (2014)

This being said, the exchange rates are also affecting the aluminium prices, as mentioned by the article “Aluminium and copper fall” (2015). In fact, the LME Aluminium price is settled in US Dollar.

2.3.1.3 Prices volatility

As seen below, the aluminium price is composed of several components, hard to predict.

In fact, as mentioned by the article the “Aluminium and copper fall” (2015), the “LME aluminium fell 0.6 per cent to end at $US 1,691.50 a tonne, the lowest since early February 2014”. This volatility is also pointed out by the MarketLine Industry Profile (2015) and the Marketwatch report (2015): the “volatility in aluminium market prices, with prices declining by 19% in December 2008 and further 11.7% down in May 2010”. In Appendix 8 can be found a LME graph, where the volatility of the prices on the 3-months buyer market is flagrant. Sanderson (2015) confirms that trend, explaining that the “prices of aluminium fell to a six-year low of $1,549 a tonne yesterday” as raw materials such as coal or aluminium become oversupplied.

With the market price, the authors also show the volatility of the premiums: while the Marketwatch report (2015) argues for “record figures by the end of 2013”, the article “Aluminium and copper fall” (2015) shows that the aluminium prices “drop, together with the collapse in global premiums, is expected to ramp up pressure on producers”.

To conclude this price determination subsection, we can say that the aluminium prices and risks are transmitted through the chain from suppliers to clients, and are determined by other factors than the basic LME price. As a buyer, it is critical to consider all the parts of the equation, including the exchange rates.

2.3.2 Aluminium supply situation

Understanding the aluminium market and inherent risks is also to comprehend the supply dynamics and trends. For lack of literature, we will focus firstly on some raw materials supply points and then tackle the aluminium side.

2.3.2.1 Raw materials supply situation

To begin with, the literature is providing some arguments about the general raw materials supply situation, which can be linked with the aluminium.

For many years during the 20th century, “the security of raw material supplies” was at the centre of the nations’ attention, notably during “the two World Wars or the Cold War” (Gandenbergeretal, 2012, in Glöser et al. 2015). Today as well, raw materials availability and criticality can “inflict serious damage on a nation's economy incorporating all industrial sectors” (Evans, 2009, ibid).

Linked to the mentioned national supply risks, Rosenau-Tornow et al. (2009) insist on the fact that “for manufacturers, all currently used raw materials of the value chain are critical for the production”. The authors are also arguing that the “cyclical fluctuations in demand, supply and prices make it difficult to reliably plan the procurement of raw material”. In this context, other authors are evoking the supply risks of raw materials. For instance, Glöser et al. (2015) insist on the “growing concerns about the security of raw material supply”.

2.3.2.2 China impact on raw materials supply

Referring to the previous mentioned situation, Rosenau-Tornow et al. (2009) note that “Chinese growth in demand (is) causing historic price hikes and delivery shortages” of mineral resources. For instance, Sanderson (2015) explains that “China accounts for 40 per cent of global copper consumption”. Furthermore, Humphreys (2013) adds that aluminium and nickel are two raw materials “where China's supply policies have had a major impact in shaping global supply”. Besides, Jusko (2009) reports that the

exportations of raw materials from China are more and more restricted to favour the Chinese domestic market consumptions.

Focusing now more precisely on the aluminium market, Mouak (2010) also mention that: “the increased activity of the aluminium industry is due to the dynamism of the Chinese economy which had a major effect on the consumption, the production and exportation of aluminium and primary raw materials such as bauxite”. To conclude, the author argue that: “China is going to have the leading role in the aluminium sector” (ibid).

2.3.2.2 Aluminium metal supply risks

First of all, Moss et al. (2013) mention the political supply risks that can arise due to the fact that “many minerals and metals are supplied almost entirely by single countries, some of which are not too highly placed when looking at the political risk indicators of the country concerned”. The authors also argue that the “risk of availability is not a quantitative factor (…) but a qualitative factor”. In fact, the MarketLine Industry Profile (2015) mentions that: “different customers may require different specifications (e.g. consistency in physical properties, variations in strength and rigidity)”, this leads to the different grades of aluminium for instance.

Also, the supply of this metal is driven by the raw material at the base of the aluminium: gallium (Moss et al. 2013). In fact, “over the coming decade a continuation of the rapid demand growth is expected to keep the supply side under pressure. For (…) gallium, it is the by-product character that poses obstacles to the expansion of supply” (ibid). In fact, the authors teach us that the gallium supply is full of political and prices risks.

This being said, Mouak (2010) argues for a shift in the buyer’s attitude while dealing with the aluminium category, linked with risk mitigation. He claims that the new “procurement professionals are using more sophisticated methods, with a better understanding of the financial markets (…). They have a more strategic vision and are developing pragmatic approaches to handle the price risk. (…) Rather than downstream integration, long-term contracts are increasing”. Furthermore, buyers are facing aluminium producers who are, according to Lapparra (in Mouak, 2010) “no longer “Customer oriented,” but who

became “Supplier oriented””. In fact, with the LME, the aluminium producer “can no longer control the aluminium ingot price” and this is the reason why they find an interest in focusing on their upstream supply chain (ibid).

Taking into account the above risks linked with the aluminium procurement, we are now going to focus on the risk mitigation strategies that can be applied.

2.3.3 Aluminium risk mitigation strategies

2.3.3.1 Supply chain decisions

Agrawal (2014) studied several aluminium and steel supply chains strategies put in place in three different car manufacturer companies. The first company has a “Hands-off RM management” strategy, meaning that the car manufacturer does not have any direct contact with the primary aluminium suppliers. On the other side, the second firm is buying the raw materials for its tier 1 suppliers (“steel and aluminium components”, ibid) and negotiating on their behalf with the primary aluminium supplier. Finally, the last company has a cooperative approach: it “involves its RM supplier, as well as all its component suppliers” (ibid). This implies notably the elaboration of a “raw material plan” and information sharing on a daily basis between all the chain links (ibid).

2.3.3.2 Information sharing

Facing the volatility of the raw material prices, and especially aluminium, Jusko (2009) interviewed a professional who were arguing for ”full pricing visibility to understand the cost drivers in the commodity being purchased“. In fact, as the market prices get tensed, he argue that the suppliers will request prices re-evaluation: that is the reason why buyers should remain up to date concerning the market trends, and “understand your supplier’s cost structure so you can protect your company’s interests in future negotiations” (ibid). Jusko (2009) was taking the example of Anomatic Corp who is using recycled aluminium and water treatment: those two points have an impact to be considered while considering the suppliers cost drivers.

Finally, Jusko (2009) and its interviewee say that is recommended “to lock in direct material contracts for more than nine months“ instead of buying in the spot markets and watching the prices increase. This brings us to the hedging strategies that can be applied to mitigate the price increases risk.

2.3.3.3 Hedging strategies

Handling the raw material costs risk, notably for the aluminium, can be done through hedging strategies. We do not aim to provide a full review of the hedging strategies, but a base to understand the mechanism to be applied within the aluminium procurement.

Mouak (2010) reminds us that a “future market is a financial market. This implies that the transactions are not about physical products but about contracts, which are commitments to be delivered or to receive the agreed quantity and quality”. In the case of the Forward contracts, the delivery is mandatory, which is not the case for the future contracts (ibid). In fact, a lot of speculation happens with forward contract (buy and resell quickly): as explained by Mouak (2010), the speculation should exist in a future market. Because the contracts on the future markets are allowing “the producers, transformers, users and operators to “block” the price for which he will pay in the future” (ibid), it will reduce the price increase risks. Nonetheless, Mouak (2010) presents the argument of Working (1962) who argues that the hedging tools are not only a risk mitigation strategy, but also a way to maximize profit. In fact, whereas the “routine hedging” (Working, 1960, in Mouak, 1962) stands for the regular “assurance contract” against the prices variations, the "selective hedging” means to hedge only if we anticipate that the prices will go down or up, and “carrying hedging” consists of “taking advantage of favourable base changes anticipated” (ibid). The base is the difference between the future price and the spot price (Mouak, 2010).

Furthermore, Mouak (2010) argues that “the precise forecast of volatility is mandatory to put in place effective hedging strategies”. He reminds us that costs cannot be avoided while using hedging strategies to cope with volatility.

The author is concluding that for the aluminium market, the hedging with the LME is effective because the level of information is sufficient.

To conclude this first part, it can be said that the supply risks, coming both from inside and outside the company, are recognized as inevitable. High raw material criticality, defined by high supply risks and vulnerability, put at risk the entire company because of supply disruptions and possible cut off of supply. To counter the identified risks, a risk management process is advised in order to identify, prioritize, prevent and follow up the risks. As we cannot mitigate all the supply risks, internal and external risks mitigation strategies are put in place by the procurement departments in collaboration with others. Concerning the aluminium procurement, we have understood the complexities and structure of this concentrated market, as well as the aluminium prices components. All this ingredients introduced linked supply risks. Also, it has been seen that supply chain visibility was key to put in place risk mitigation strategies, such as mass purchasing, cost breakdown or hedging.

Based on the previous information, the second part will introduce the results of the field research as well as the recommendations to WestRock.

Part 2: Field research

This second part of this research is focused on the research conducted by the researcher among diverse companies on the selected subject. The first subsection aims to explain the research methodology used while the second subsection will present the main results. Last but not least, the third subsection will bring recommendations to Westrock Company.

1. Research methodology

1.1 Secondary research

This study began with the secondary research, which is the already written literature on the risk management and aluminium procurement. Seen in Part 1, the work aims to do a state of the art before initiating the primary research.

The secondary research has been done mainly via Internet and online resources from May to June 2015. Were used mainly procurement and supply chain professional journals and websites, market reports and thesis. The literature was almost exclusively written in English.

Concerning the risk management literature, it was quite easy to find accurate data and articles on the subject, while the literature was harder to find concerning the aluminium procurement. In fact, there is a lack of literature concerning the aluminium market, procurement and risk structures.

Nonetheless, the literature was sufficient to provide a good base for analysis and to introduce the primary research results.

1.2 Primary research

In order to have open conversations and better understand the specialities of the companies interviewed, a qualitative research was done via guided interviews. The interviews were done in parallel with the writing of Part 1, in July and beginning of August.

Seven persons were interviewed, representing six different companies. The respondents were chosen according to several criteria: whether the company is buying raw materials and/or aluminium, the size of the company and procurement spend, the industry and its international presence. This selection resulted in having a set of companies representing different sectors and sizes. In table 4 below can be found a sum up of the interviewees. Please note that for confidentiality reasons, some figures are either not indicated or approximate. The aim is to give an idea of the sizes and industries of the interviewees companies.

Table 4 Respondents List - Primary research

	Position	Industry	Employees worldwide	Procurement spend - global	Raw Material spend
Company A	RM buyer	Transportation	Around 20 000		
Company B	RM Buyer	Parts manufacturer	Around 6 000	Less than 400M €	3,6M €
Company C	Non ferrous procurement director	Electronic components	Around 160 000	12 b €	750M €
Company D	Lead buyer	Cosmetics	Around 80 000	Confidential	Less than 750M €
Company E	Procurement director	Electric equipment	Around 8 000	500M €	50M €
Company F	Senior procurement manager	Beverage	Around 15 000	More than 500b $	Less than 750b €

Once the phone interviews done, three main themes were selected to be part of the field research results, using a thematic analysis approach. As a result, the following sub-section aims to make a parallel between the literature review findings and the interviews results.

2. Field research results

In this subsection, we will first approach the various procurements and supply chains organizations playing a critical role in the aluminium risk mitigation strategies determination. Once the interviewees' companies structures have been understood, the aim of the following part will be to present the identified aluminium stakes and risks. Finally, the risk mitigation strategies will constitute the last part of the field results discussion.

Please note that other raw materials will be covered in the discussion as the interviewees mentioned critical points that can be linked or applied to the aluminium procurement.

The Appendix 9 provides an overview of the companies supply chains, while Appendix 10 provides a summary of the interviewee's responses about the identified strategies and the associated risks.

2.1 Aluminium procurement structure

Nowadays, the aluminium procurement is part of the raw material category in many firms, that is the reason why we will be lead to embrace the raw materials procurement instead of only aluminium.

To understand the procurement structure, we will first introduce the aluminium procurement supply chain and then the RM procurement organization. In fact, the structures and organizations seem to have an impact on the supply risk level, even if it was not clearly stated in the literature.

2.1.1 Supply chains organizations

Among the companies represented in the sampling, we can witness the different supply chain organizations linked with the industry and business model. As explained in Part 1

by Agrawal (2014), the various supply chains organizations are impact their risks levels and strategies.

In Appendix 9 are summarized the sampling companies supply chains: this allows us to clearly identify the differences. Please note that only company B is not buying aluminium but metals (steel, stainless steel, brass) and that whereas company A is buying steel directly from the producers, this has not be part of the discussion.

Talking about business models and supply chains, every company in the sampling is buying the aluminium-based components, except company C, which has a Make and Buy business model. In fact, the company still has industrialization means and therefore is buying primary aluminium rather than partly finished products. Nonetheless, company C is still buying finished aluminium pieces, like the other interviewees. The company D explains that they are not allowed to buy directly from the primary aluminium producers, who are also called the smelters (e.g. Rusal, Alcoa…). As it will be explained later on, company C is monitoring the aluminium prices without directly buying the raw material. The company F has the same approach.

Among the companies, we can also see that the aluminium pieces received from the suppliers will be industrialized afterwards. Each company will integrate the aluminium pieces into their final product and as a consequence industrialize them: for instance, companies D and F will fill in the pieces while company B will cut the metal pieces.

Each supply chain organization brings its own risks and complexities, as seen in part 1. As it can be seen in the table, some companies are using intermediaries between the tiers: these strategies will be approached in the risk mitigation part in details.

Among the sampling, the majority of the firms do not have any contact with the primary aluminium producers. For the company F, the supply base is quite limited and with some experience, the tier 2 or 3 suppliers can be deduced. Otherwise, the interviewee mentioned that the suppliers do not share their primary aluminium suppliers. On the other side, the manager interviewed from company C is having the opposite position, meaning that he knows every primary aluminium suppliers that tier 1 suppliers are using.

The interviewee mentioned for example the companies Alcoa, Constellium or Novelis. This confirms the ranking and major primary aluminium producers introduced in part 1. Furthermore, company E is sharing this idea, defending that tier 1 suppliers are easily sharing their supply chain, even if the company does not represent a huge weight in their sales.

To conclude, we have seen that the companies have various supply chain types, buying different type of partly finished aluminium or metal products, and do not have the same visibility on their supply chain tiers.

2.1.2 Procurement organizations

Knowing the structure and level of information shared in their supply chains, as well as their Make and/or Buy strategies, it seems relevant to understand how the companies interviewed have structured their procurement organizations. The focus will notably be on the raw materials category.

Firstly, we can notice that the company D procurement department is organized with project buyers (with a brand orientation), and with category managers. The category managers are in charge of the technical categories, are oriented towards the suppliers and are handling the raw materials prices fluctuations. The same category managers can be found in company F. In this company, the procurement department is organized between the direct and indirect teams and the process teams (data and systems). The primary packaging category managers belong to the direct procurement teams, while the warehousing, MRO or the commercial function support belongs to the indirect category. We can note that the metal crowns put on the top of glass bottles are bought by the glass category managers and not by the metal packaging managers.
In the company D and F, the raw materials and more particularly the aluminium procurement, are done by the category managers who can be for instance in charge of the metal packaging procurement. Close to this organization, company E explained that

because raw materials can be found in every component they buy, there is no specific raw material category of buyer.

At the opposite, company A has a specific raw material team, in charge of the forecasts and price variations impact on the final sell price but also in charge of the contracts negotiations and controlling. This team is providing support to the buyers who are daily involved with the purchased pieces.

Another close configuration is the matrix procurement organization of company C, which can be found in figure 9. This firm includes the raw materials procurement in its “Market” dimension, in charge of define, deploy and respect the strategy elaborated to manage global suppliers. This dimension includes the global raw materials market (ferrous, non ferrous, plastics), along with the fabricated components (FC) procurement notably.

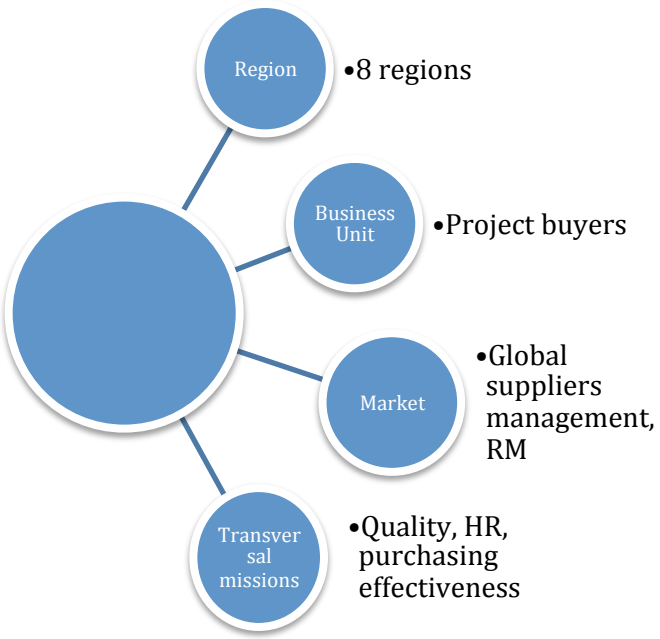


Figure 9 Company C procurement 4 dimensions

Finally, the company B has a local and global structure, where the raw materials are bought at the two levels. In fact, the interviewee explains that at the local level, the buyers are responsible of buying the RM, components and subcontractors for the entity. They are negotiating the raw materials prices for those that are not handled at the global level. In fact, at the global level, the key category managers (KCM) are taking care of the annual negotiations and of the coordination between the procurement families. The interviewee explains that the key category managers will, in the near future, determine the strategies with the global suppliers. This structure can get closer to company A organization, handling the negotiation and orienting the local buyers.

In this sub-section, we had an overview of the different procurement structures and aluminium supply chains present in the sampling. As we can foresee, the risks are not the same whether the company is buying directly its primary aluminium or whether the company has not visibility on its supplier's tiers. We will now approach the different stakes and risks cited by the respondents, profoundly linked with their company structures and supply chains.

2.2 Aluminium stakes and risks

The seven respondents reported different types and level of risks concerning the aluminium procurement. In the following sub-section, we will firstly review the financial risks cited by the interviewees, then the supply chain, supplier failure and market risks.

2.2.1 Financial risks

2.2.1.1 Prices volatility

One of the stakes identified by the company D is to "monitor and anticipate the economic impacts" of aluminium procurement, as the prices are volatiles. The main risk explained is the risk of price increase: in fact, to get a competitive advantage, the firm

should have the competitive prices on the market. To miss the opportunity has a direct impact on the business P&L… with millions of euros of impact.

Towards the same idea, the company F explains that the aluminium is a risky commodity because of the trading on the market, the funds mechanisms and the market volatility, because of speculation. Among other authors, Mouak (2010) sustained the same idea.

On the other side, company A is sharing that the only risk could be the price, because of the aluminium price structure (LME index, premiums). Making a parallel with the plastic category, the interviewee claims that the risk is higher considering the oil prices increase and the “force majeures” in the market.

2.2.1.2 The LME and Premiums impacts

The prices volatility is highly due to the premiums and storage part of the aluminium price. In Part 1, Madden (2014) introduced the idea, linking this to supply chain risks while the MarketLine Industry Profile (2015) and the Marketwatch report (2015) state for a volatile aluminium market.

This idea is sustained by company C, arguing that “the huge volatility of the premiums have a major impact: so everything that is not index related should be passed on to the client”. This argument of passing through the costs to the client is also sustained by Madden (2014) in Part 1, arguing that this way, the volatility of prices is transmitted through the supply chain.

The interviewee also insists on the fact that the company cannot master and hedge the premiums and therefore that it is not what he called “procurement non-performance”. Furthermore, company F is sharing the idea that the premium volatility and increase are a risk that cannot be hedged, and that it is an “artificial cost exploited by certain institutions, that goes up and down without real reasons”. The respondent from company D is sharing the same incomprehension of the premium calculation.

At the same time, company D brings critical elements to understand the functioning of the London Metal Exchange market (LME) and the reasons behind the premiums and prices volatility. The manager argues that, by invoicing the storage costs, the LME is fictively increasing the premiums to encourage consumers to get out the aluminium and consume it. The smelters (e.g. Rio Tinto, Rusal, Corus Tata…) are even getting incentives for them to put the aluminium in storage. In fact, the interviewee argues that the stock levels visible on the LME website are much lower that the real total stock levels: "if that real figure is declared, the premiums will collapse". Because "only 20% of the LME signed contracts are for a physical consumption, the rest is buy and resell, without any change in the stock levels". The respondent from company D adds that the LME is a "contango market, because it is always increasing". In fact, he argues that the aluminium price is increasing with the number months of storage: the LME is better off keeping the aluminium in storage in order to increase the prices. Mouak (2010) and Egloff (2013) also sustained this idea in Part 1, talking about intermediaries for storage and LME warehouses. The Marketwatch report (2015) also mentioned the excessive LME stock levels.

Towards the idea of a blurry index system, the company A argues that for the raw materials procurement, the choice of index remains critical, while "we do not know what's behind the index". The raw materials market being very opportunistic, the market and index knowledge remains important with not global indexed materials. For the ferrous raw materials applied in the plastics manufacturing, company C explains that while there is no recognized global index, the firm should succeed to buy at a better price than market. For the non-ferrous materials, the respondent indicates that 99% of the procurement is index based: "LME, Shanghai index, COMEX, depending on the region".

2.2.1.3 Exchange rates

Whereas some respondents argue that the LME does not disrupt the market, other mentions some drawbacks of the LME market, and notably related to exchange rates. In

Part 1, the article “Aluminium and copper fall” (2015) also explained the impact of exchanges rates on the aluminium prices.

In the sampling, the interviewed companies are mainly based in Europe, so this risk is certain. In fact, company D argues that the main disadvantage of the LME is to buy in US dollars. He argues that as the currencies are a FOREX market, a huge volatility exists, and the “buy and resell” behaviour is predominant. Companies A and E also explained the currency risk. Company E has an exchange risk with every raw material they are buying. To counter that, they established strategies that will be develop in the next sub-section.

2.2.2 Supply chain risks

2.2.2.1 Supply disruptions

Beyond the economic impacts mentioned by company D, the supply risk anticipation is a critical stake. As cited by Snell (2015), having visibility above the first supplier tier is not enough to handle the risks and considered them as supply chain global.

In fact, the supply disruptions that can occur within the aluminium supply chain are bringing a huge risk for the entire business: without the raw material, no business is possible as the production stops quickly. This reminds us the disruption risk evokes by Guertler & Spinler (2015) and Ellis et al. (2015) in Part 1. During the interviews, company B also argues in favour of important stakes and risks of supply disruptions for the metal supply. The respondent explains that the reassurance of the supply with a decrease of the supply delivery period and development of consignment stocks are major stakes. The main risk cited for the metal supply is the supply time needed to deliver the right quantity of metal.

Finally, company C argues that the aluminium market has few risks, contrary to the steel market. Nonetheless, he stresses that it is critical to follow up on the deliveries to get the material: vision shared with company D.

2.2.2.2 Supply chain efficiency

The respondent from company A explains that the raw material team has an eye on the supplier process while selecting the suppliers transforming the primary aluminium to avoid potential shortage risks. For instance, the team will look at the foundry age, the overhead, the general processing. In fact, the company A does not deny the supply risks linked with the outsourcing decision, idea brought out by Carter et al (2010) in Part 1.

Towards the efficiency of the supply and processes, company C argues that the focus is now about how the primary aluminium producers and the partly finished aluminium parts producers are handling their energy consumption. According to the interviewee, it will because more and more critical in the following years because the industry is energy intensive. A better handling of the energy costs is mitigating in advance the price increase risks and assures a better return of capital employed. In Part 1, Mouak (2010) also argues in favour of a high-energy consumption in its aluminium cost breakdown analysis.

2.2.3 Supplier failure risks

2.2.3.1 Profitability

Among the seven participants, four of them mentioned the supplier failure risks and more particularly their profitability level, from the medium procurement spend to the larger one. In fact, company C is putting the supplier failure risk at the first rank of aluminium procurement risk, because of the supplier's low profitability levels. In fact, as mentioned in Part 1, the evaluation of the suppliers should also be in term of "bankruptcy" according to Guertler & Spinler (2015)

The respondent from company C is indeed insisting on the fact that the monitoring of the suppliers financial health is important given the market concentration and mitigated financial results of the aluminium suppliers. Furthermore, company D explains that the Chinese aluminium primary aluminium producers have further profitability issues, rising

further risks in addition to the geographical ones. At the opposite, Company F explains that the margins of companies such as Rusal or Alcoa are not a concern for the procurement team. Nonetheless, company E insists on the fact that the supplier failure risk exists for every raw material purchased.

2.2.3.2 Quality

In parallel, it is interesting to notice that company B, a parts manufacturer, tends to be more focused on the expectation of quality, as explained by the two respondents of this company. In fact, the main risks explained by the first respondent from company B is the materials quality and the requirement respect from the metal suppliers. In this case, the quality should be present from the firsts tiers until the last. The automotive industry is indeed particularly waiting for high quality levels in final pieces: this starts with the raw materials. The respondent explains that the team could not source local Chinese steel because of the poor quality: this can also be applied to the aluminium parts category.

2.2.4 Market risks

2.2.4.1 Availability

On the raw material market, the availability question is still current. Nonetheless, company A and F explained that there is no shortage in the aluminium market supply. In fact, company A argues that several sources can be found in the world because the company is buying a standard grade of aluminium. This statement goes against what Mouak (2010) argues, saying that the aluminium is “one of the not renewable resources with one of the higher trade value”. Also, the market thinness expressed by Ellis et al (2015), and also sustained by Mouak (2010) concerning the aluminium market, refutes the company A interviewee saying.

Last but not least, company A adds that to avoid this shortage risk, the foundries have several primary aluminium suppliers or resellers. Company F also shares this analysis saying that the market was steady with no shortage; the challenge is only for them to

lock-in the right quantity to hedge it (see 2.3.1). In fact, as explained by Moss et al (2013) in Part 1, the “risk of availability is (…) a qualitative factor”: right quality, right grade etc…

2.2.4.2 Geopolitical risks

At the same time, the market risk cited by almost every participant was the geopolitical risks linked with the purchase of aluminium. As Guertler & Spinler (2015) agued in Part 1, this external phenomenon has a direct impact on the hole supply chain. Munoz et al. (2015) also reminded us that “the situation is hardly stationary” and the predictions are impossible.
First of all, company D explained that in order to buy aluminium at the right time, the geopolitics should be taken into account. The Chinese consumption is notably to take in consideration, as explained in Part 1 by Rosenau-Tornow et al. (2009) and Mouak (2010).

The interviewee from company F is also sharing this assessment, explaining that the excess of availability in China is a real challenge, as the consumption continues to keep going up, the suppliers have to remain competitive and supply the right amount and aluminium quality. The Chinese consumption impact on the worldwide raw material supply and prices is also cited by company B, who explains that for steel, the evaluation of the Chinese consumption is important to foresee the steel prices evolutions. This interviewee also adds that macroeconomics risks should also be considered, such as the anti-dumping laws when an Asian raw material enters the European Union (duties).

Finally, its seems relevant to mention the choice of company C, that, despite the important geopolitical risks in the Middle East, chooses to source a part of its aluminium parts (extruded aluminium) in this region because the suppliers are handling efficiently their energy consumption.

To counter with the mentioned risks linked with the aluminium procurement, the respondents provided strategies that they are putting in place in their firms.

2.3 Risk mitigation strategies

In order to understand the strategies proposed by the respondents, the following sub-sections will evoke by theme the answers provided. As described in Part 1 by Banchelet (in Tréhan, 2014), all the risks cannot be handled. Therefore, companies are putting in place strategies to mitigate the risks they can have an influence on and have as much impact as possible to reduce the consequences.

Following the respondents answer, we will firstly mention the hedging strategies that can be put in place, then the contractual strategies that can be decided to mitigate the aluminium procurement risks. Finally, the various internal tools the interviewees mentioned will be explored.

Before developing the strategies, can be found in table 5 the summary of the respondents' main mitigation strategies, which is whether the companies have clear aluminium risk mitigation strategies, and their nature. The complete summary can be found in Appendix 10. The strategies will be developed in the following parts; this table only aims to sum up the differences between the interviewees.

Table 5 Respondents risk mitigation strategies

Company	*A*	*B*	*C*	*D*	*E*	*F*
Strategy	Not formalized	No	Yes	Yes - by every category manager -	Yes	Yes - by every category manager -
Types	Team to reduce price variations - contracts	Will be the KCM mission in the future	Hedging, contracts, tools	Hedging, tools	Hedging, contracts, tools	Hedging, contracts, tools

2.3.1 Hedging strategies

As explained in the above sub-section, the financial risks in the aluminium procurement were cited by a large part of the participants, and the strategy explained is hedging.

Mouak (2010) largely explained that strategy for the aluminium procurement is in publication.

First of all, company D explains that in order to put in place this strategy and buy future contracts, the company needs to have precise and accurate consumption forecasts. Company F, who argues for a stable internal reporting and forecasting, also shares this view. In fact, the cancellation of a future contract leads to costs once it is bought. The buyer needs to know the most precisely possible the monthly aluminium consumption (because of the storage costs), which is a complicated work to do. The advice given by the interviewee is to use historical data while entertaining a close relationship with the consumers (in the plants) and with the business (sales teams). This strategy allowed the respondent to build a “consumption plan” and to a detailed the plan per every supplier and plant to supply (from Europe to Brazil or China). The company D is not buying directly from the primary aluminium suppliers (tier 2) for its tier 1, as explained by the respondent, it is rather a financial commitment of consumption. The supplier is assured to sell X tons of aluminium parts but in compensation, the supplier should buy when the company D tells it. Because the LME cannot be reverberated but only anticipated, the category manager of company D is committing to an average price per ton in order to have a stable sale price to present to the business for the year. This allows the company D to fix the profitability until 36 months, even if the respondent does not advice this length with such a fluctuating market.

At the same time, as seen in part 1, other types of contracts exists to hedge. Company E and D are both saying that the option contract was not chosen. In fact, company D explains that after a thorough study, the option was too expensive for the firm as the volume was not important enough versus the option costs.

At the same time, company E and F also explain that they have a hedging strategy for the raw materials procurement. Company F explains that in the past they were hedging via their suppliers to lock in a certain price per quarter: now they have a risk committee to take care of that (see 2.3.3).

Concerning the company E, the concept consists for the suppliers to dip into the raw materials stocks that have been bought at a defined price. This is notably the case for the zamak (zinc, aluminium, magnesium alloy) for which the company is hedging to be covered 3 to 6 months minimum ahead. Also, with the companies who are injecting the aluminium, company E offers a price based on the LME, and after discussions, the price is blocked on the period. While the other participants did not mention the bank, company E is also using banks to hedge and mitigate the financial risks. The choice depends on the supplier size: if the supplier is not “big” enough, the company E will not directly work with the LME, but rather with the bank. The bank will guarantee a price level, and if the price increases or decreases, the bank or company E (depending on the case) pays the difference. Nonetheless, the interviewee mentions that he prefers the hedging on the market because are negotiated a price and a physical delivery, whereas with the bank hedging strategy, no physical delivery is mentioned, which can increase the supply disruptions risk. This can be linked to the interviewee from company D, who argues that with this type of contract, the material will be delivered to the firm exactly the day planned in trucks. From a treasury perspective, the company will have to pay cash the delivery amount. Finally, contrary to the other participants, the company E teams are also hedging currencies, given the exchange rate risks mentioned. This point will also be explained in the contractual strategies part.

Nonetheless, company C argues that because the company is listed on the stock exchange, putting at risk the margin with contracts at the LME is not possible for all the raw material purchase, contrary to company D or E. The company F is also sharing this strategy, as only a part of the aluminium procurement is hedged, and the rest of the amount remains open. As a consequence, for company C, only 60 to 70% of the copper and aluminium procurement is hedged through a fixed price on the period. This is the reason why the company procurement teams are using other risk mitigation strategies for the raw material procurement notably.

To conclude, the hedging strategies allow the companies to mitigate at best the prices volatility of a category such as the aluminium. In addition, it allows the supply chain to

avoid the disruptions by planning the delivery of the raw material several weeks or months in advance.

2.3.2 Contractual strategies

Beyond mitigating the prices of the aluminium or any other raw material following the same trend, companies are also focusing on other risk mitigation strategies that, beyond the prices orientation, demonstrate the shift of the procurement function as a strategic one.

2.3.2.1 Contract clauses

The first and well-known leverage for the buyers are the clauses and contractual points to be negotiated for the contract in collaboration with the raw materials suppliers. As explained above, company D agreed with their aluminium parts suppliers (tier 1) to buy the primary aluminium when company D's category managers decides it is the right time in the market to buy at a competitive price for a suitable delivery date. In return, the supplier is certain to sell its partly finished aluminium parts to company D. This deal allows each party to gain supply visibility and price stabilization.

Furthermore, company A adds that it is important to supervise the suppliers with contracts indicating the index to be used for the price update, the grades, weight… In fact, with the aluminium, the negotiation is rather limited notably because of the indexed base price. Linked to the same idea, the second interviewee of company B indicates that for volatile raw material markets, it is recommended to include clauses that framed the prices updates according to an agreed base price, if the material is not indexed (stainless steel for instance). Alongside with or in replacement of the base price to be agreed on, the interviewee from company E adds that the procurement team is in charge of the negotiation of a "tunnel price": above a certain level, the supplier and company E will renegotiate the price as the variation is either too high or too low for each party.

According to Jusko (2009), the price re-evaluation should be done with full market knowledge as well as the suppliers cost drivers: the participants did not mention this necessity. Nonetheless, Jusko (2009) also advises to lock in the prices for several months: the large majority of the interviewees mentioned this contract strategy.

Last but not least, company F is also citing some points that can be negotiated though the contract clauses: contingency options (cf: suppliers plants), back up plans, supplier management programs. This can be linked with the statement from Ellis et al (2010) in Part 1, who were arguing in favour of “flexible manufacturing, back-up systems and spare capacity”.

This leads us to the following paragraph, the supplier relationship management strategies.

2.3.2.2 Supplier relationship management

Beyond the strategy of company D who’s category manager advises the suppliers for them to buy at a certain date to brokers at the LME, others respondents are explaining that buying or negotiating on behalf of their tier 1 suppliers is common practice. Company A does not apply this strategy, while the respondent explains that some are applying that strategy as they are fully informed about the tonnage and aluminium grades, representing a significant weight facing primary aluminium suppliers. Linked to that, company E explains that it would not be worth doing for them because they do not have enough volume. As a matter of fact, he adds that the suppliers are better leveraging the volumes on their own because the aluminium parts suppliers are bigger than company E. Nonetheless, the respondent explains that they are doing this strategy for the copper procurement, as the volumes are bigger.

Furthermore, as seen previously, company C is both buying primary aluminium and partly finished aluminium parts, as part of their Make and Buy strategy. The interviewee from company C explains that the two divisions taking care separately of the two types of procurement is not easy, but the goal is to consolidate the aluminium procurement, as they did for copper. In fact, each division is potentially having the same suppliers, but not

at the same tier: as an example only, we can imagine the supply chain illustrated in figure 10 to understand the issue. As explained by the respondent, the internal approach is to compare the prices paid by the divisions with the same suppliers, compare, and globalized the needs through grouped procurement.

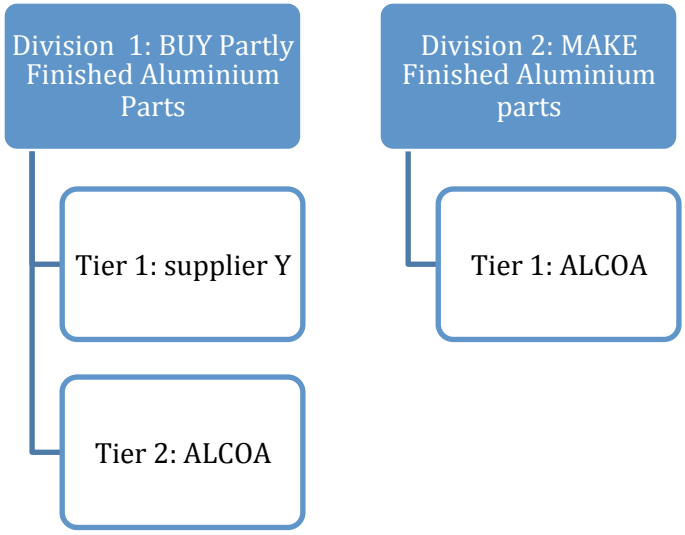


Figure 10 Procurement consolidations - company C example

At the same time, company E argues that to mitigate the exchange rates risks, the company is suing multi-currency invoicing and double invoicing. This means that to remunerate a supplier, company E can pay a part of the invoice in euro, another part in dollars or in yen… or all in dollars if the supplier is invoicing in dollars only. Furthermore, the interviewee explains that the dollars received with the sale of company E products are used to pay the suppliers in dollars: this is call back to back. This way, the supplier relationship is strengthened as the supplier is paid quickly and the exchange rates risks in mitigated.

Last but not least, a strategy to secure the aluminium parts supply could be for a supplier to become a client. In fact, as explained before, company C argues that the Middle East aluminium extruders have a lower energy cost than the European suppliers. As it is also a competence of company C, the partnership built can engage the suppliers

to hire company C for them to even better manage their energy consumption, according to the interviewee. Of course, this can be done with only a few numbers of suppliers.

2.3.2.3 Review the need

As we have seen, contrary to many other raw materials, the aluminium availability is not yet a critical risk. Company C followed the logic, comparing two materials the company is buying: copper and aluminium. The strategy applied by the company was to replace the copper parts into aluminium parts. This way, the company is reducing its supply risks linked with the copper with a lower risk level with aluminium. Tréhan (2014) also mentioned this strategy arguing that the best way to remove the risk and supplier dependency was to transform or delete the need for the material. This can start with a functional need analysis in order to determine if the material can be substituted. In Part 1, Ellis et al (2010) also explained that the market thinness was sometimes self-imposed by the procurement department because of the material chosen. The strategy of shifting from one component to another goes in the right direction to reduce the market thinness and the supply risks as argued by the authors.

2.3.3 Internal tools

2.3.3.1 Committees

Half of the interviewed procurement professionals described a committee in charge of the company risks. Among them, two large companies and a middle size company: which can bring us to think that this strategy is not a question a size. In fact, as mentioned in the literature review by Tréhan (2014) there is a need for the designation of a person for the risk prevention. Furthermore, Carter et al. (2010) also argued the need for a risk management team, involving finance: this is close to the below committees.

Firstly, we can cite company C, with its supplier risk committee: the risk mitigation is placed at a high position in the group strategy. For each market, this committee follows the level of risks, especially about the raw materials. At the same time, company E also

have a risk committee, in which seat the finance and treasury department of the company: it deals with the raw materials risks as well as the currencies (double-invoicing and multi currency invoicing strategies). Finally, company F explained that all of their aluminium procurement was not hedged, only a part of it. The rest being open, this is the treasury committee that decides the amount to hedge and the amount to leave opened at the market.

2.3.3.2 Electronic systems

As explained in Part 1 by Hoyt & Liebenberg (2011, in Sherman et al. 2014), an "integrated, enterprise wide data on risk" was needed as a risk mitigation strategy: below some respondents provides examples of electronic systems to be used.

Firstly, it seems relevant to mention an element brought by company D about the LME. In fact, in order to mitigate the price volatility and utilized hedging strategies, the buyers should better understand the LME organization and functioning. For that, the interviewee explained that the LME has an important information system, about the stocks levels, but also a great training course that cost approx. 4 000$ and is dispensed all over the world.

At the same time, other participants explained that electronic systems were used to mitigate raw materials and aluminium risks. For instance, company C explained that every buyer has access to an RMI tool. Every buyer should enter in the tool their consumption, and follow the prices evolutions thanks to indexes. If the buyer succeeds to buy at a better price than the index price, then it is procurement productivity. The RMI tool is following in the entire company the prices and the procurement performance. This tool also allows the sales teams to reverberate the raw materials increases to adjust the prices with relevant reasons and easily explicable reasons. Without this tool, the interviewee argues that it would not be possible to trace the procurement non-performance (prices increases). Furthermore, the interviewee adds that another tool is used for each buyer to evaluate the risk levels: criticality level, action plans, tools in the intranet to have access to supplier information. Company C has put in place this kind of

tool after the Fukushima event: according to the interviewee, the company went from a risk management strategy of reactivity to anticipation.

Last but not least, the smaller company interviewed (company E) argues that the main tools are left to the suppliers, as they are bigger and major companies of the sector. Nonetheless, they are using electronics tools such as databases, tables reporting and daily contacts with LME main actors.

2.3.3.3 Other tools

As mentioned in part 1, numerous other tools exist to mitigate risks: they will be developed in this paragraph.

To start with, company A explains that the raw material team is using a supply chain mapping for the pieces that are critical and mostly used in production. This mapping involves knowing who does that in the chain, to identify where the pieces are coming from, and identify possible issues quickly. This tool clears the supplier, as every step is known, according to the interviewee. The suppliers are providing this information easily, but one reason could be that company A represents an important weight on the supplier's revenue. Nonetheless, as explained by Tréhan (2011) in the VIE model; the supplier motivation can also be a reason for sharing easily its supply chain structure.

Also, other respondents mentioned the matrixes that can be elaborated to determine the risk levels. Company C mentioned the "9 boxes matrix" as well as the supply chain risks, geopolitical risks, the financial risks or also the natural risks to be evaluated in parallel. The aim with this tool is to remove the suppliers with a high risk., that can be identified with colours. After this matrix, action plans are taken, and taken to the risk committee for assessment and action taking. Company E also mentions the risks matrix, and added that they were comparing them with the ones made during the previous years. Nonetheless, company B argue that in smaller companies, the concept of the matrixes are not in paper, but kept in mind by the buyers, because of time pressure. For the respondent, it is more of a mind-set, rather than absolutely put on paper. Furthermore, company D adds that he did not have a risk matrix for the aluminium, because for the

interviewee, the material exists in profusion and the risks of the material were better on the supply and forecasts side.

Alongside with the matrixes tools to be applied, company F adds that the buyers are using a “reconciliation report” for them to track every credit or debt depending on the aluminium market trend versus initial forecasts. This report is not done by company F every month, but gives a good analysis of the actual debt and credit on this raw material.

To conclude, the above strategies allow the companies from the sampling to mitigate the risks linked with the aluminium and other raw materials procurement. We should also add that the skills of the buyers, such as knowledge of the LME, being attentive to the market or having relevant monitoring tools are as much as important as the actual tools.

Having taking into consideration the interviewees elements as well as the literature review, we will now provide some recommendation to WestRock EMEA procurement department.

3. Aluminium procurement: recommendations to WestRock

This last section aims to provide to WestRock EMEA procurement department with some practical recommendations to improve the aluminium risk identification and risk mitigation strategies.

3.1 Introduction

Similar to some of the respondents, WestRock Home Health and Beauty business unit does not buy aluminium directly but rather metal parts that are directly integrated into the production lines in the plants (Germany, Italy and Spain). The Geneva Headquarter procurement department is dealing with the global contracts and global projects involving several plants inside and outside of Europe, and usually does not negotiate

local agreements, which are handled by the local purchasing teams (for small volume or bespoke needs).

From a general point of view, the alignment between the local managers and category managers in Geneva is hard to achieve. For instance, there are no negotiated contracts with the metal suppliers because of a lack of volume forecast leads to a non-volume commitment from the plant.

From a supply chain perspective, the sourcing teams do not have supply chain visibility beyond tier 1. The figure 11 is showing the tier 1 suppliers, which are the metal parts suppliers, who are buying rolled aluminium at the tier 2 level. The tier 3 is mostly the primary aluminium supplier, already mentioned in the previous sections. The tier 2 and 3 can of course be the same supplier. Because of the lack of supply chain visibility, this is constructed from discussions with the suppliers: for instance, we know that our suppliers are buying mostly buying from the same supplier. Nonetheless, we do not know exactly the supply base of the tier 1 suppliers and the prices conditions they have with tier 2 and 3.

The tier 1 suppliers are located in Europe, mostly in Spain and England.

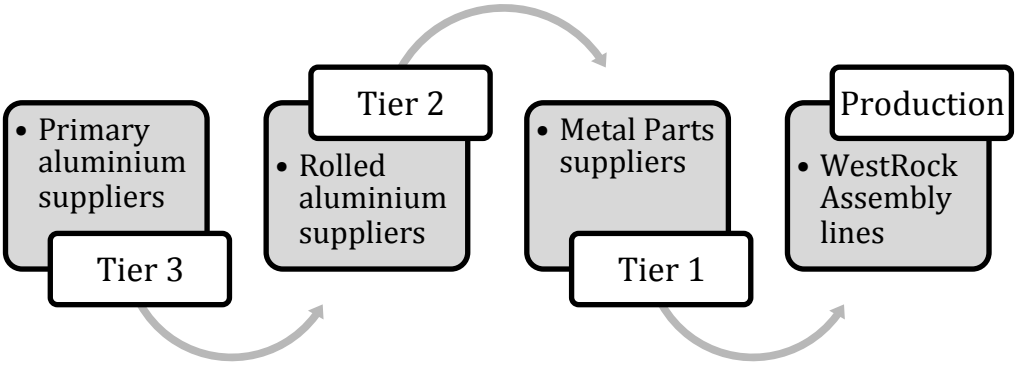


Figure 11 WestRock metal parts suppliers tier 1 and 2

Knowing this supply chain structure, several risks are arising. The table 6 is summarizing the risks identified in the previous sections applied to WestRock. They are also ranked from the most important risk identified for the EMEA aluminium procurement to the least important risk identified for the region. We can note that the legal risk is not cited as a top risk for the category. The company notably integrated a clause in the purchase terms were the suppliers agree not to subcontract without the buyer agreement.

Table 6 Metal parts risks levels, WestRock EMEA

Risks	Level (EMEA)
Supplier financial health, bankruptcy	8
Premium volatility	7
Supply disruptions	7
Quality	7
Prices volatility	5
Supplier process, efficiency	5
Availability	4
Exchange rates	3
Geopolitical risks	2

Being a stock exchange listed company, WestRock do have risk mitigation strategies deployed to every commodity. From the U.S headquarters, the category managers have several documents to fill in every month, per quarter or on a yearly basis. Concerning the metal, the risk mitigation tools are obviously not concerning the tier 2 or 3, but only tier 1.

The risk mitigations strategies now in place within the company will be confronted with the recommendations in the following sub-sections. The recommendations are classified from a time perspective in order to quickly identify the feasibility and commitment needed.

The full table and summary of the strategies currently applied, the strategies applicable and non-applicable can be found in Appendix 11. Concerning the non-applicable

strategies, the researcher aims to demonstrate that WestRock is not ready for these recommendations, considering the procurement resources as well as its maturity or culture. Nonetheless, the recent merger could have a beneficial impact on financial hedging strategies and LME training/new trained buyer recruitment in Europe. Today, the data is not available enough to forecast precisely, month by month, the metal parts consumption: this will be a big challenge for the future. Concerning the strategy for a supplier to become a client or a need renewal, it seems hard to predict.

3.2 Recommendations timeline

3.3.1 Short-term strategies

Firstly, we concentrate on the short-term strategies that can be applied within 3 months. The tools and strategies presented in this sub-section are either close to the current tools used or they do not require a substantial investment so can be implemented quickly.

3.3.1.1 Contracts implementation

The first recommendation that can be given to the company is to implement contracts with the metal parts suppliers in the short-term. For that to happen, the team will have to convince the local sourcing teams to commit to minimum delivery volumes without annual reliable forecasts. This process is initiated but is not being completed because several departments have to be involved. Involving the upper management both in the European headquarters and in the plants could speed up the process. Furthermore, while negotiating supply agreements terms, the recommendation would be to include a reliable index, as it has been mentioned both by the literature and interviewees. Beyond the aluminium, this can be applied to other raw materials. Currently, resin contracts have been carefully studied to choose the right index for prices updates: the analysis could be done for the aluminium with the “tunnel price” described by the company E. This would

mean that in the contract, the supplier and WestRock should agree on a minimum and maximum spread beyond which the price has to be renegotiated. This analysis can rely on the existing market reports sent by the third-party provider (Beroe) on a monthly basis. These recommendations can help reduce prices variations and better anticipate them. Also, the contract will allow WestRock to evaluate more deeply the metal parts suppliers' financial health, to mitigate the related risk of failure.

In the ST, share the contract bases and the "tunnel price" with the metal parts suppliers.

3.3.1.2 Supplier classifications

Firstly, a supplier matrix can be completed, like for example the critical suppliers matrix presented in part 1 (Appendix 4). Close to Kraljic matrix, the analysis aims to evaluate the business impact of the supplier in case of supply disruptions, and on the other side the identified supply risks, to obtain the supplier position on the matrix.

Once the tier 1 shared their aluminium suppliers, this analysis can be done more deeply as the risk level will change, for example if they have only one primary aluminium supplier. Furthermore, this analysis would be more relevant if done per plant, to be more precise in the critical suppliers identification and follow-up.

Thanks to the supplier matrixes, WestRock will be able to determinate the supplier "watch list" within the category. This "watch list" will gather the supplier the most at risks and to monitor more closely. This recommendation will allow the raw materials procurement teams to better allocate resources.

In the ST, WestRock can put in place a matrix per plant to identify the critical suppliers to be on the "watch list" and share with the plant for them to be attentive to any supply issues.

3.3.1.3 Supply chain mapping

The supply chain mapping arises from a sharing of the metal parts suppliers. From a time perspective, it seems relevant to do this exercise with the critical suppliers identified per plant (cf: matrix).

This mapping will allow the company to reduce supply disruptions risks and to gain supply chain visibility over the other supplier's tiers: this is to be done in close cooperation with the suppliers. For the suppliers to share their supply chain, WestRock will most likely have to work on the supplier motivation level (Tréhan, 2014, VIE model: valence, instrumentality, expectation) to convince them to share information because WestRock do not represent a high percentage on their sales volume.

This supply chain mapping should also be introduced as a way to quickly identify the issues in collaboration with the metal parts supplier and share the supply disruption risk. Furthermore, this supply chain visibility will allow WestRock to gain information about the financial health of the other supplier's tiers, and identify potential weaker suppliers. Of course, this tool can be initiated in the short-term but it will only be implemented and pay dividends in the medium to long-term.

In the ST, involve the suppliers during face-to-face meetings to explain the approach and encourage them to give WestRock supply chain visibility. Start with the suppliers under the "watch list".

3.3.1.4 RMI tool

In the short-term, the whole tool as put in place in company C cannot be implemented, nonetheless, variations of this tool can be. Currently, the Google tools are used in the company, notably Google Sheets and Documents: this allows several persons to have access and modify the document at the same time. Using this Google sheets, a variation of the RMI tool can be conceived.

Referring to the tool utility for company C, this tool will enable WestRock to:

- Have visibility on the metal consumption and prices evolution versus the index
- Identify procurement productivity and procurement non performance
- Communicate with the sales team for them to adjust the pricing according to the raw material increases

Of course, this tool can be extended to other critical raw materials, such as resin, in order to have a comprehensive picture of the raw material situation, shared with other departments. Procurement productivity and non-performance definitions should be agreed and aligned with the management, and most certainly linked with the savings and cost avoidance calculations.

In the ST, create a comprehensive shared document to be updated on a monthly basis by all the parties involved.

3.3.1.5 Risk management committees

For each recommendation to succeed, the involvement of other departments beyond sourcing is mandatory, as well as the support of the upper management.

This brings us to the risk management committees, involving all the raw materials types, beyond aluminium. The concept could be put in place in the short-term with the upper management support, while the implementation and the setting up of the committees will take time.

The idea behind the risk committee, as explained by several respondents, is to involve other departments in the risk mitigation strategies. The risk management committee would be in charge of evaluating the supplier risks per category and evaluate the potential risk mitigation strategies viable for the company. The committee will specifically

monitor the suppliers on the "watch list" for each category. Currently, the matrix in Appendix 13 is used in the company for every commodity, updated quarterly.

With participation of finance and sales, this committee will be very useful if the company decides to pursue hedging strategies or to review the raw material need. For now, these strategies seem hard to apply, but the situation may change rapidly due to the recent merger.

In the ST, involve the finance, quality and sales department notably, to take stock of the current risk levels and establish risk mitigation strategies taking into consideration all the departments needs.

3.3.1.5 Risk management policy

To conclude, all the recommendations can be included in a new risk management policy, which can be implemented for all the raw materials procured. In fact, as mentioned by some authors, having a policy regulating the risk management will allow a smoothly process by all the parties, and a better risk monitoring. From the supplier selection to the supplier performance management, the risks considerations have to be systemized and included in a process. For each procurement steps, a risk mitigation action is indicated for the teams to follow. The contract building, the supply chain mapping, the completion of the RMI tool, and the risk committee will be included in each step of the process and clearly identified in the policy (please refer to Appendix 11).

In the ST, WestRock could implement a formal risk management policy to be presented to the concerned teams and share risk mitigation strategies to be taken into account at each procurement process' step.

As we have seen with these recommendations, several of them need time to be implemented, which brings us to the medium-term actions to be put in place.

3.3.2 Medium-term strategies

Medium-term strategies will take longer (but should be achievable within the year), because they require more time and investment from the company.

3.3.2.1 Short-term strategy implementation

As mentioned in the previous sub-section, the short-term strategies have also to be planned in the medium-term. The risk committees have to be implemented through time and the supply chain mapping should be spread to all the metal parts suppliers.

Following the contract implementation, a cost breakdown analysis could be initiated with the most strategic suppliers in order to better understand their process and reduce the risks linked with their process/efficiency as well as bankruptcy risks. This analysis would be particularly relevant if the supplier is strategic but is also on the “watch list”, and integrated to the process (Appendix 11).

In the MT, follow up the right implementation of the risk management committees and the supply chain visibility expansion, while initiating cost breakdown analysis with selected metal parts suppliers.

3.3.2.2 Multi currency invoicing

The currency issue has been discussed in the sourcing department a few months ago while a British metal parts supplier reviewed the prices upwards, following the USD/GBP and the GBP/EUR exchange rates important variations. This incident reminded to the

team the existing exchange rates risk, and that no strategy was put in place to mitigate it.

Taking the example of company E, the only recommendation that could be made to reduce exchange rates impact on metal parts prices would be to initiate the multi-currency invoicing, based on the back-to-back process. In fact, as a worldwide company, WestRock is being paid in multiple currencies, which could be used to pay the metal parts suppliers, such as the American and British ones. This recommendation would need to be studied at a more global level to reach its maximal savings potential, implicating the upper management.

Another recommendation would be to learn more about how the metal suppliers are handling their exchanges rates: USD/EUR for euro-zone suppliers, and additional currencies for non euro-zone suppliers. This could be integrated in the risk management procurement process (please refer to Appendix 11).

In the MT, engage the relevant stakeholders and launch the multi-invoicing and back-to-back strategy at the upper management level. With current suppliers, investigate on their current exchange rates risk management strategy.

3.3.2.3 Supplier risk information availability

Currently, information about the risks linked to a particular supplier are not available for every current supplier and in one platform. Each category manager, analyst or supply chain manager can add information on the Google Site created by the procurement department of the Home, Health and Beauty Business Unit. In this site was recently created a page where the financial check reports (D&B reports) requested by the buyers can be found. This financial check is now done more regularly, but one recommendation would be to include that check in the procurement process and risk mitigation strategies of Appendix 11.

In order to reduce the supplier financial health risk as well as the metal parts supply risk disruption, the recommendation would be to extend the availability of the information. Leaning on the previous recommendations (Supply Chain mapping, cost breakdown, matrix, etc…), the risks levels per supplier should be shared and updated on a regular basis. The audits effectuated by the plants local quality department should also be updated regularly and shared. In fact, because WestRock encountered several quality issues with the metal parts suppliers, a thorough monitoring and follow-up of the quality issues should be done and shared.

Company C explains that tools to consult this information was present on the intranet, and updated by the buyers with the RMI tool. The concept would be to empower other departments about risk management by sharing the available information with them. Furthermore, the information would be available both to the local teams and to the risk management committee, allowing them to take more accurate and fully informed decisions.

In the MT, integrate the supplier financial check into the risk management process. Initiate a global project to integrate an intranet tool to consult the supplier's risks levels, as well as their quality status. Engage the local teams into the process.

3.3.3 Long-term strategies

Finally, the long-term strategies to be explained in this last sub-section are strategies that require a substantial amount of resources, time and upper management commitment.

The tools previously described, started on the short or medium term from now, have to be put on a long-term footing to continuously mitigate the aluminium and metal parts category risks. The below recommendations take a step forward, leaning on the previous ones. Furthermore, it is important to remember that the recommended

strategies will only to realizable if the category manager in charge has the full responsibility of the category, and preferably worldwide.

3.3.3.1 Volumes consolidations – mass purchasing

As seen before, tier 1 suppliers do not share their precise supply chain, and neither do they involve WestRock in their aluminium procurement. This is the reason why this recommendation is to be applied in the long-term, as the previous recommendations should be in application before this one can be.

The idea behind the volume consolidation would be to convince the more strategic metal parts suppliers to put their volume together and buy this new aluminium foils volume to one selected supplier (mass purchasing). For WestRock tier 1 suppliers, it would be to mitigate the aluminium prices and premiums volatility by buying aluminium in collaboration with their competitors. Also, this will have an impact on the suppliers' gross operating profit.

A study should be made by the metal parts category manager in collaboration with each of the selected suppliers in order to determine everyone's volumes and preferred supplier. Because the metal parts suppliers are buying at the same aluminium foils suppliers, a common supplier should not be difficult to agree upon. Once this volume analysis done, the negotiation with the chosen aluminium foils supplier can begin. As agreed with the metal parts suppliers, WestRock metal parts category manager will do the negotiation on behalf of the suppliers. The contract details will have to be negotiated, taking into consideration the previous contract conditions of the metal parts suppliers to obtain better contractual conditions.

In the LT, use the information collected from the previous recommendations to consolidate the metal parts suppliers' aluminium procurement. This aim to reduce the prices volatility risks as well as to strengthen the supplier's relationships.

3.3.3.2 RMI tool spread – volume forecasts

As explained in the short-term strategies where a simple version of the tool can be implemented, the real nature of the RMI tool is to be used by all the regions, and beyond the metal parts. This tool implementation and spread has to be carried by the upper management of WestRock. With the merger, it can be expected that the new procurement leadership will solve the current forecasts issue, which notably prevents the metal parts category manager to establish accurate forecasts and procurement strategies. The new company, WestRock, also has new synergies to expect, and this RMI tool can be an electronic solution to achieve goals such as supplier consolidation, alignment, and accurate consumptions forecast. This tool would notably be useful to consider the worldwide supplier base and notice if two regions have the same metal parts suppliers without the same conditions. This can be applied to every category, and aim to have ”one voice to supplier” behaviour.

To conclude this recommendations sub-section, it seems relevant to mention the consequence of inaction concerning the metal parts risk mitigation strategies for WestRock EMEA sourcing team. The first argument is about the prices volatility risks and the incapacity to get accurate forecast for budget, as without contract, the supplier can adjust the prices multiple times a year. Furthermore, if any quality or supply disruption occurs, WestRock does not have any supply chain visibility upon their suppliers’. Furthermore, it is seems critical to establish more strategic relationships with the metal part supplier, and gain trust in both sides. For that, the local teams will have to be convinced not to change metal parts suppliers often, as it can be done now.

Also, it is critical to remind that the above recommendations could be put in place only if the upper management (beyond procurement) supports the new tools and strategies for the metal parts. Also, it is critical to remind that without curiosity, technological surveillance and solid monitoring documents, the risk identification and mitigation cannot be sustained.

Finally, as a new merged company, WestRock seems to be a great opportunity for deep changes in practices, with the above recommendations that can be applied to other commodities.

Conclusion

Global raw material sourcing implies critical risks that procurement departments are now in charge to handle, notably through risk mitigation strategies. In fact, beyond the “cost killer” image of the procurement department, purchasing new role is more oriented towards value creation and risk management. In a context of global competition, mitigate procurement risks such as supply disruptions and prices volatility are critical to sustain a competitive advantage and secure profitability.

Thus, the first part of this research aimed to introduce the theoretical aspects of supply risk management as well as the aluminium related risks. We have seen that the risks driving factors are located both internally and externally, bringing supply disruptions and potentially a cut off of supply. Internally, recent procurement strategies such as lean manufacturing or subcontracting are leading to increased supply chain risks that procurement departments have to mitigate. For that to happen, we have seen that a risk management process can be implemented, as well as externally and internally oriented mitigation strategies. Focusing more on the aluminium procurement, we have learnt the aluminium market and supply chains complexities, going with the various components of the aluminium price. Knowing the main players in the concentrated aluminium market and the stakeholders, we have approached the strategies present in the literature: supply chains decisions, information sharing and the hedging strategies.

Based upon the first part clarifications, the second part of this research was the field results. In the first sub-section, the interviewee’s feedback on the subject was explained, by looking at their supply chain structures and then at the aluminium procurement risks and stakes. Among the respondents, we noticed that the companies put different business models and supply chains organizations in place, having a direct impact on aluminium risks levels. We have seen that the main aluminium procurement risks lie in the prices volatility, the supply disruptions, supplier failure and in the market organization. To mitigate the above risks, the participants mentioned hedging strategies,

contractual strategies as well as internal tools to be applied and put in place in the company.

In the second sub-section, we have introduced the recommendations to WestRock and the metal parts category. The recommendations were categorized according to the evaluated time of setting up: short-term, medium-term and long-term. We have instated on the fact that the recommendations would work only if the upper management is involved and supportive and if the category manager is fully empowered. For the long-term strategies, a real change concerning the means and responsibilities allocated to procurement is needed, as well as a global implication. The challenge will also be the decentralized organization and the raw materials category manager's leadership skills more than ever needed to convince the local teams to implement the strategies. Also, it is important to remind that the next months after the merger can bring new opportunities to put in place the recommendations, because a lot of things are changing.

In this conclusion, we can say that through this research we have looked at an almost inexistent research field, which are the aluminium procurement risks and mitigation strategies. The limits to this research are notably the number of interviewees rather limited to draw universal conclusions, and the lack of deeper literature for part 1. The next step would be to study whether the hedging strategies are as effective as presented by the interviewees within major companies.

Concerning WestRock, it would be relevant to review the situation within a year. This way, the team will be able to analyse the progress and adjust the tools and strategies put in place. If the recommendations were convincing for the aluminium category, they can be implemented for other raw materials and identify high risks materials that can be replaced with alternative less risky materials. This type of project would put the procurement department in a leadership position to increase innovative projects within WestRock.

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Appendices

Appendix 1 - Classifications of risks, created from Lockamy et al (2010) and Kumar et al (2010)

Appendix 2 - Disruption and operational risks, created from Guertler and Spinler (2015)

Appendix 3 - Risk prevention, by Tréhan (2014)

Appendix 4 - Criticality matrix, in Gloser et al. (2015)

Appendix 5 - Identify critical suppliers, by Carter et al. (2010)

Appendix 6 – Aluminium consumption in 2002, from Mouak (2010)

Appendix 7 - Aluminium supply chain, adapted from Egloff (2013)

Appendix 8 - LME price graph - 3 months Buyer - 2014 2015

Appendix 9 - Sampling – companies supply chains

Appendix 9 - Sampling – companies supply chains

Appendix 10 – Interviewees results summary

Appendix 11 – Recommended strategies: short-term, medium-term, long-term

Appendix 12 - Procurement process and risk mitigation strategies - Metal Parts

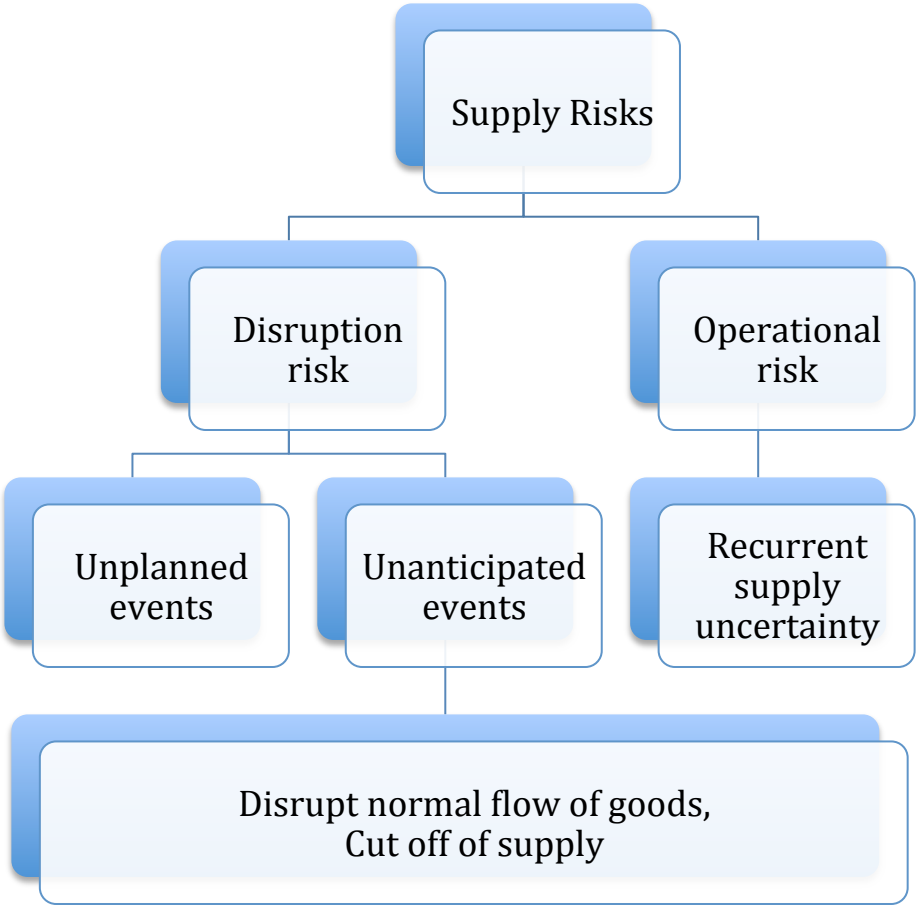
Appendix 13 – WestRock current risk matrix

Appendix 14 – Déclaration anti-plagiat - déclaration

Appendix 1 - Classifications of risks, created from Lockamy et al (2010) and Kumar et al (2010)

From Lockamy *et al* (2010)	**Kumar *et al* (2010)**
Operational risk => *Quality, delivery, service issues*	Demand risk => *Demand Forecasting*
Network risk => *Supplier structure network*	Production and distribution risk => *Production failure*
External risk => *"External forces"*	Supply risk => *Goods flow*
	Interaction risks in Supply Chain => *Politics, Economics…*

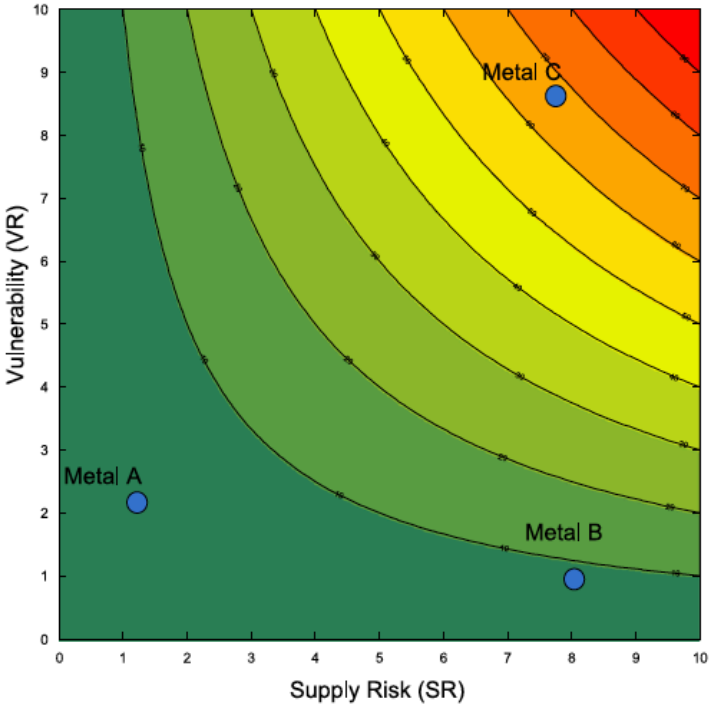
Appendix 2 - Disruption and operational risks, created from Guertler and Spinler (2015)



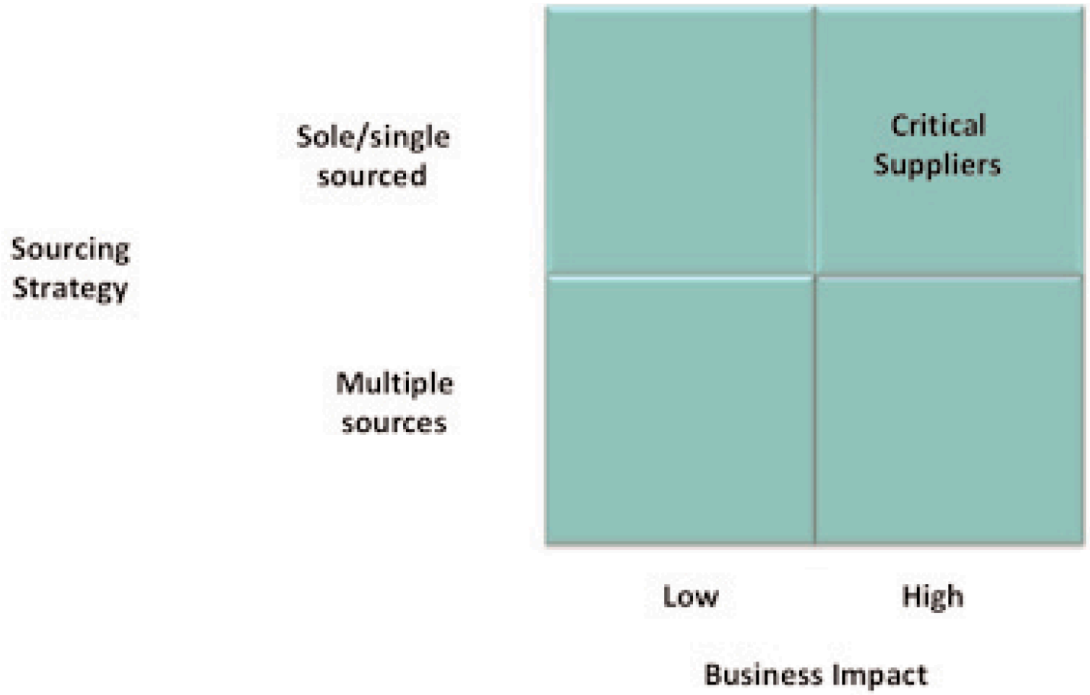
Appendix 3 - Risk prevention, by Tréhan (2014)

Choice	Preventing measures
Avoid the risk	
Change the likelihood of the occurrence	- Improve selection of suppliers - Key suppliers training - Cost breakdown analysis - Monitor regularly suppliers - Dual sourcing to develop
Change the consequences	- Emergency plans - Business continuity planning - Contingency plans
Share the risk	- Contracts, insurance, business alliances
Retain the risk	=> Residual risk after reduction and transfer of the risk.

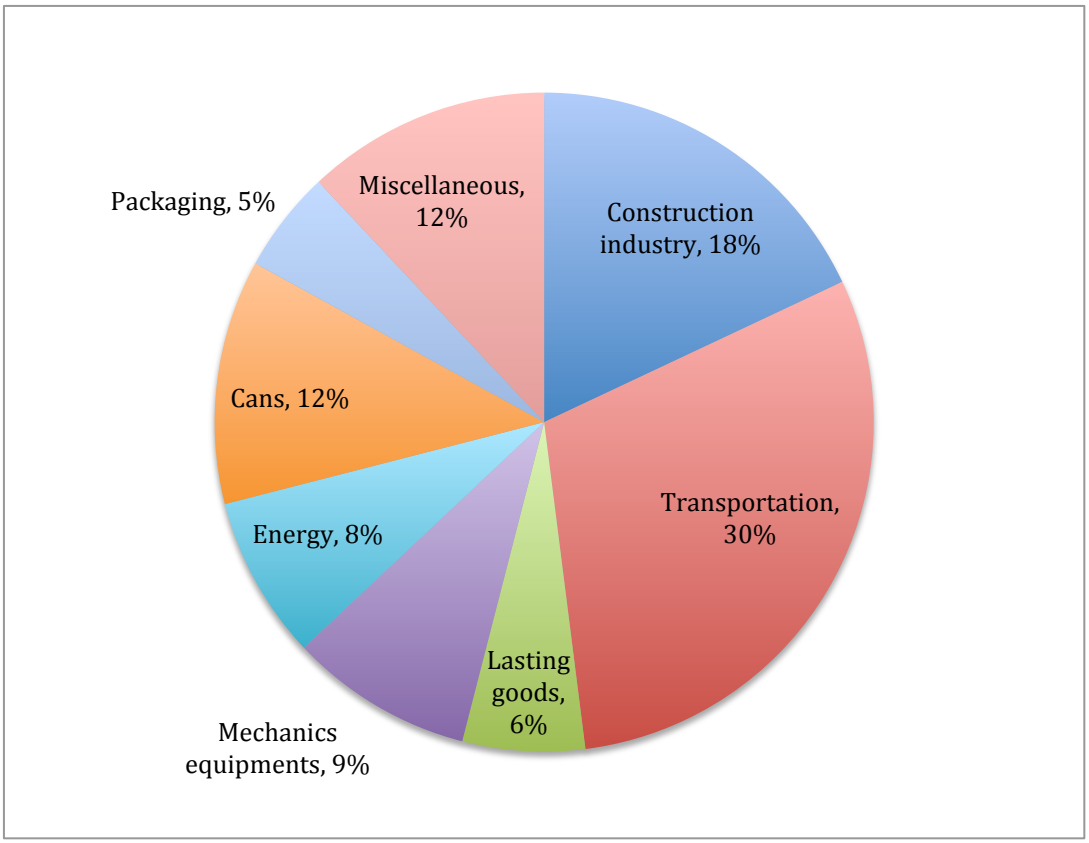
Appendix 4 - Criticality matrix, in Gloser et al. (2015)



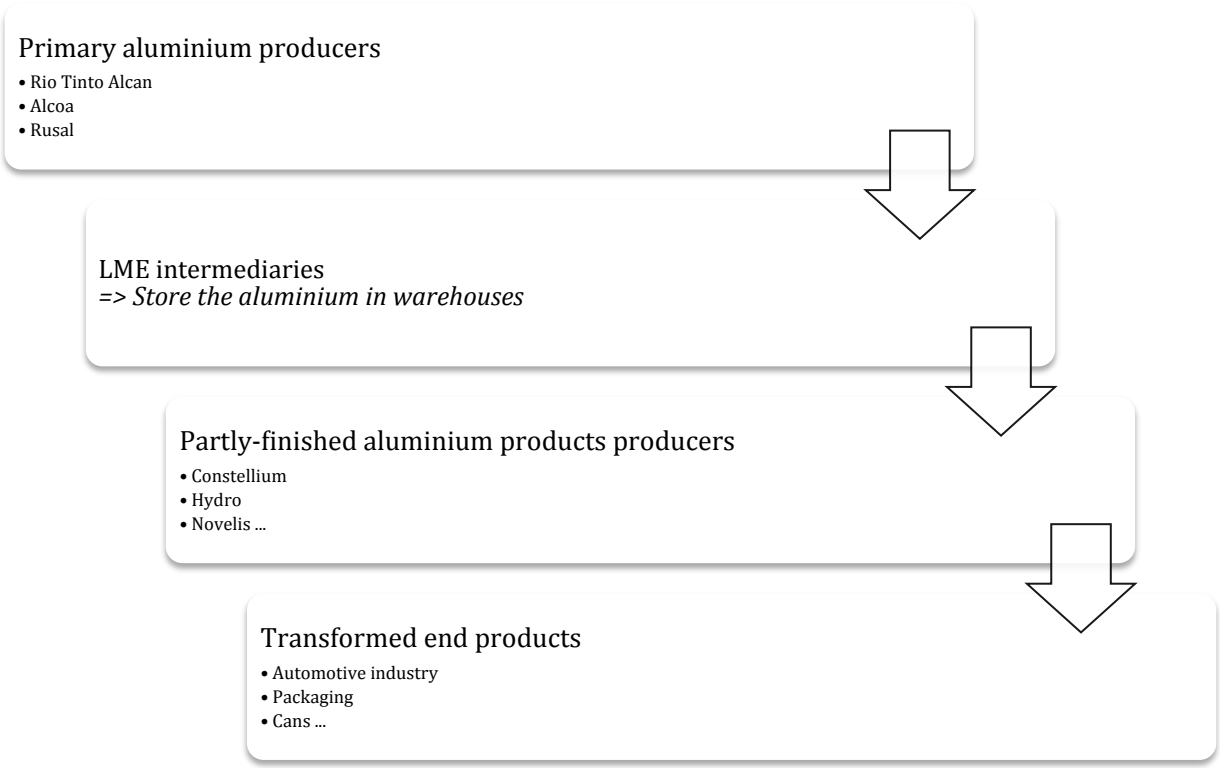
Appendix 5 - Identify critical suppliers, by Carter et al. (2010)



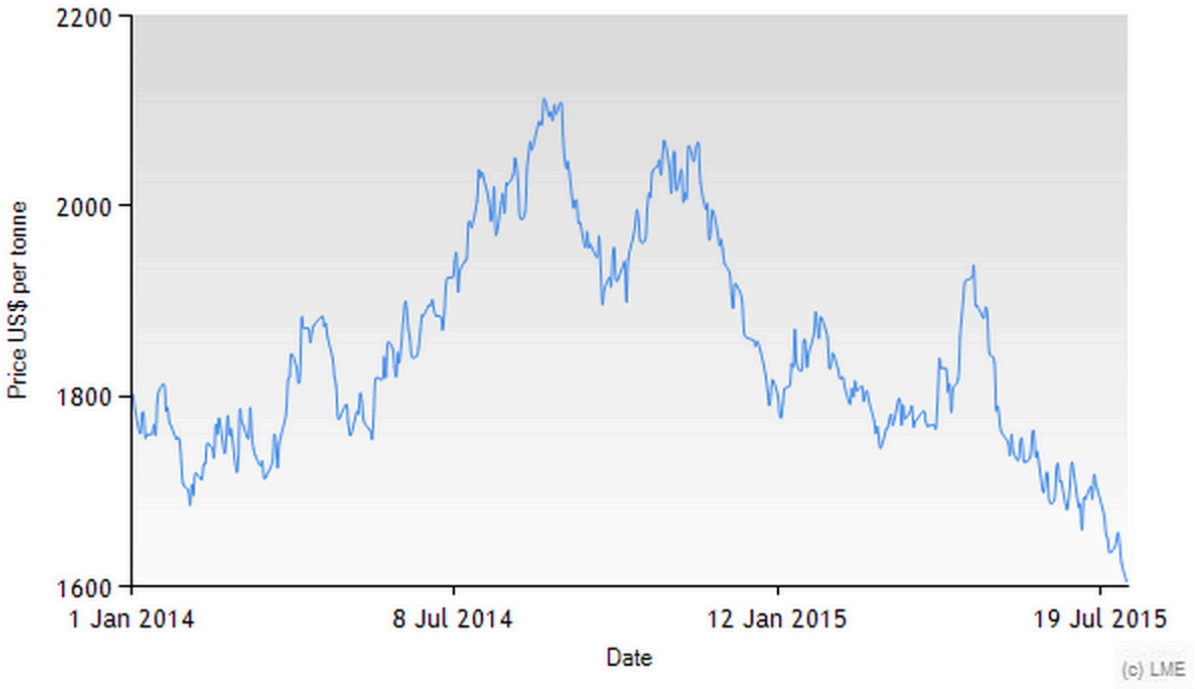
Appendix 6 – Aluminium consumption in 2002, from Mouak (2010)



Appendix 7 - Aluminium supply chain, adapted from Egloff (2013)



Appendix 8 - LME price graph - 3 months Buyer - 2014 2015



Appendix 9 - Sampling – companies supply chains

Company	A	B	C		D	E	F
	Buy	**Buy**	**Make**	**Buy**	**Buy**	**Buy**	**Buy**
Next step	To be integrated in the final product	Plant: Use in the cutting press	Industria-lization in the plants	To be integrated in the final product	Plant: fill in the aluminium packaging	To be integrated in the final product	Plant: fill in the cans
Product delivered	Finished aluminium pieces	Finished aluminium pieces	Aluminium sheets	Finished aluminium parts	Aluminium parts components	Finished aluminium parts	Empty cans
Tier 1	Smelting plant	Smelting plant	(Primary) Aluminium suppliers	Metal parts supplier	Metal packaging suppliers	Metal parts suppliers	Can suppliers
Intermediaries				*Try to negotiate aluminium for tier 1*	*LME brokers, traders*	*Not worth negotiating for tier 1*	
Tier 2	(Primary) Aluminium supplier	Metal supplier		(Primary) Aluminium suppliers	(Primary) Aluminium suppliers	(Primary) Aluminium suppliers	Sheet providers
Tier 3							(Primary) Aluminium suppliers can be tier 2 or 3

Appendix 10 – Interviews results summary (1)

Mitigated risks	Practice	*Company A*	*Company B*	*Company C*	*Company D*	*Company E*	*Company F*
Financial and market risks	**Hedging**	Not mentioned	Not mentioned	Hedging but because the company is listed, only 60% to 70% of the volumes are hedged	Have accurate information, use historical data to build a consumption plan. Tell the supplier when to buy. Option contract Not mentionedt chosen	Option contract Not mentionedt chosen. Suppliers are dipping into the RM stocks bought defined price. Depending on the supplier size, can use the bank to hedge. Currencies are also hedged	Have stable internal reporting and forecasting to hedge. Option contract Not mentionedt chosen
All	**Risk committee**	Not mentioned	Not mentioned	Yes, risk at a high position in the company' strategy	Not mentioned	Not mentioned	Used to lock in a price per quarter, hedging via the suppliers: now the committee is taking care of that
Financial and supplier failure risks	**Contract clauses**	Supervize suppliers with contracts: index to be used for prices updates, grades, weight..	Include clauses to frame the prices according to agreed base price, if no indexed material. Consignment stocks	Not mentioned	Agreement with the supplier: have the volumes but agree to buy when company D decides.	"Tunnel price" negotiation	Contingency options, back up plans, supplier management programs
Market risks	**Back up plans**	Yes, have multiple sources, common grade	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Financial, market, supply risks	**Buy for tier 1**	Not mentioned	Not mentioned	Yes. *Make and Buy strategy:* the two divisions are looking to massify the aluminium procurement and buy for the company *(Make)* and for the tier 1 *(Buy)*	Yes	Not worth buying for tier 1 because they have bigger volumes on their own	Not mentioned

Appendix 10 – Interviews results summary (2)

Financial risks	**Multi-currency invoicing and back to back**	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Yes. Invoice payment with several currencies to mitigate the risk. Back to back strategy: the dolalrs received with the sales are use to pay the suppliers	Not mentioned
Supplier failure, supply, financial risks	**Supplier to become a client**	Not mentioned	Not mentioned	Primary aluminium suppliers willing to reduce their energy costs: also Company C core business	Not mentioned	Not mentioned	Not mentioned
Supply, financier, market risks	**Review the need**	Not mentioned	Not mentioned	Replacing copper by aluminium because the supplyand availability risks are lower	Not mentioned	Not mentioned	Not mentioned
All	**Electronic systems**	Nothing particular mentioned, regular information systems and excel sheets	Nothing particular mentioned	**RMI TOOL**: Buyers enter their consumption, follow the prices evolution, indexes. Track procurement productivity and performance. Allow the sales teams to adjust and justify a price increase due to RM. **Criticality levels, actions plans, Intranet tools**	Nothing particular mentioned, regular information systems and excel sheets	Tools are left to the suppliers, because they are bigger companies. Use of **databases, reporting tables**	**LME Website**: critical information to better understand the functionning. Also courses available

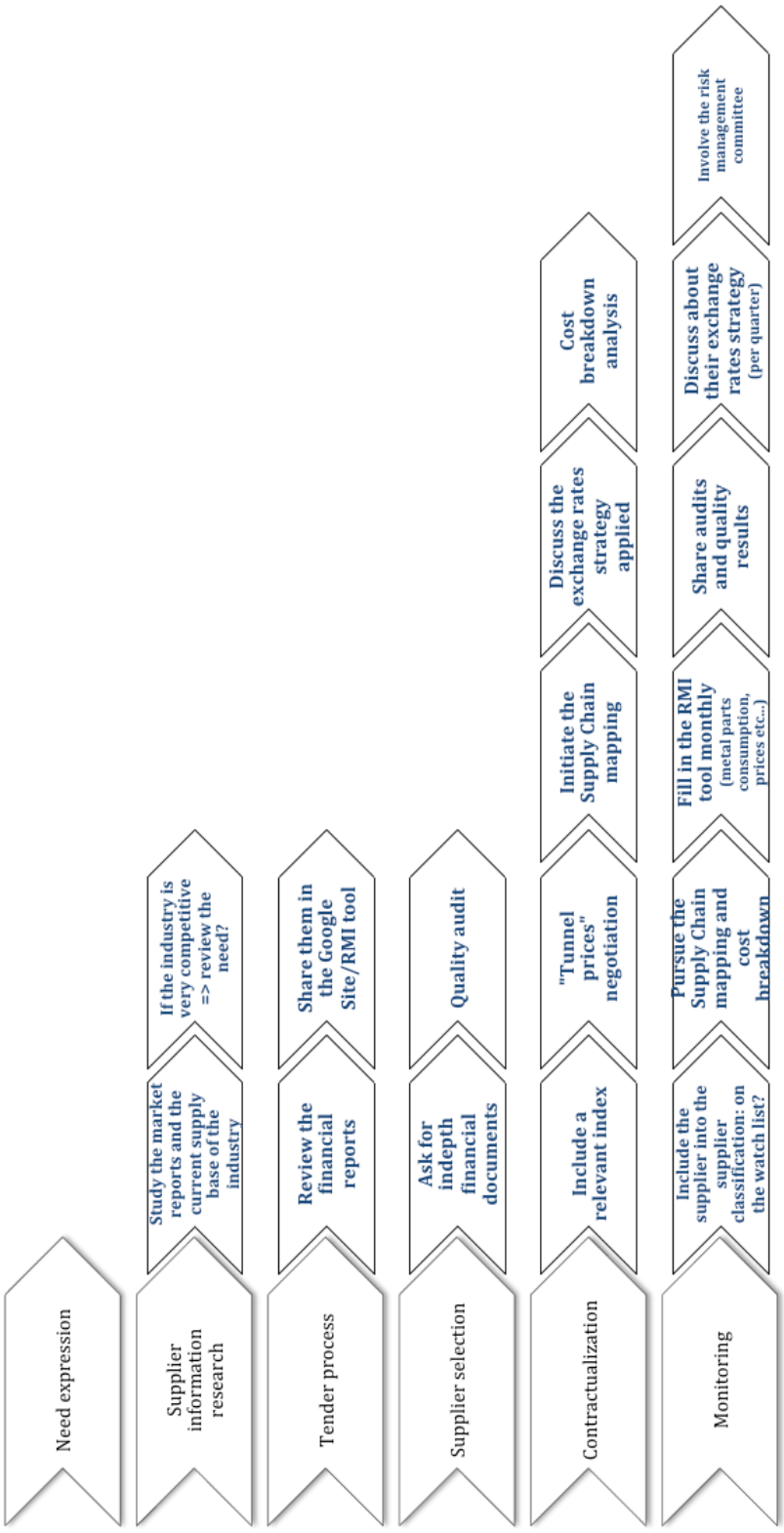
Appendix 10 – Interviews results summary (3)

Supply and supplier failure risks	**Supply chain mapping**	Yes, for the high runners, to know who does what in the chain, quickly identify potential issues	No - Try to have as much visibility as possible	No - Try to have as much visibility as possible	No - Try to have as much visibility as possible	No - Try to have as much visibility as possible	No - Try to have as much visibility as possible
All	**Risks Matrix**	Yes	No - smaller company, do not have time to formalize the matrix	9 boxes matrix => by identifying the geopolitcal risks, supply chain risks, financial risks, natural risks	Not formalized for aluminium	Yes, and compare the new matrix with the previous year risk matrix	Yes
Financial risks	**Reconciliation report**	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Yes, track credit and debt versus initial forecasts

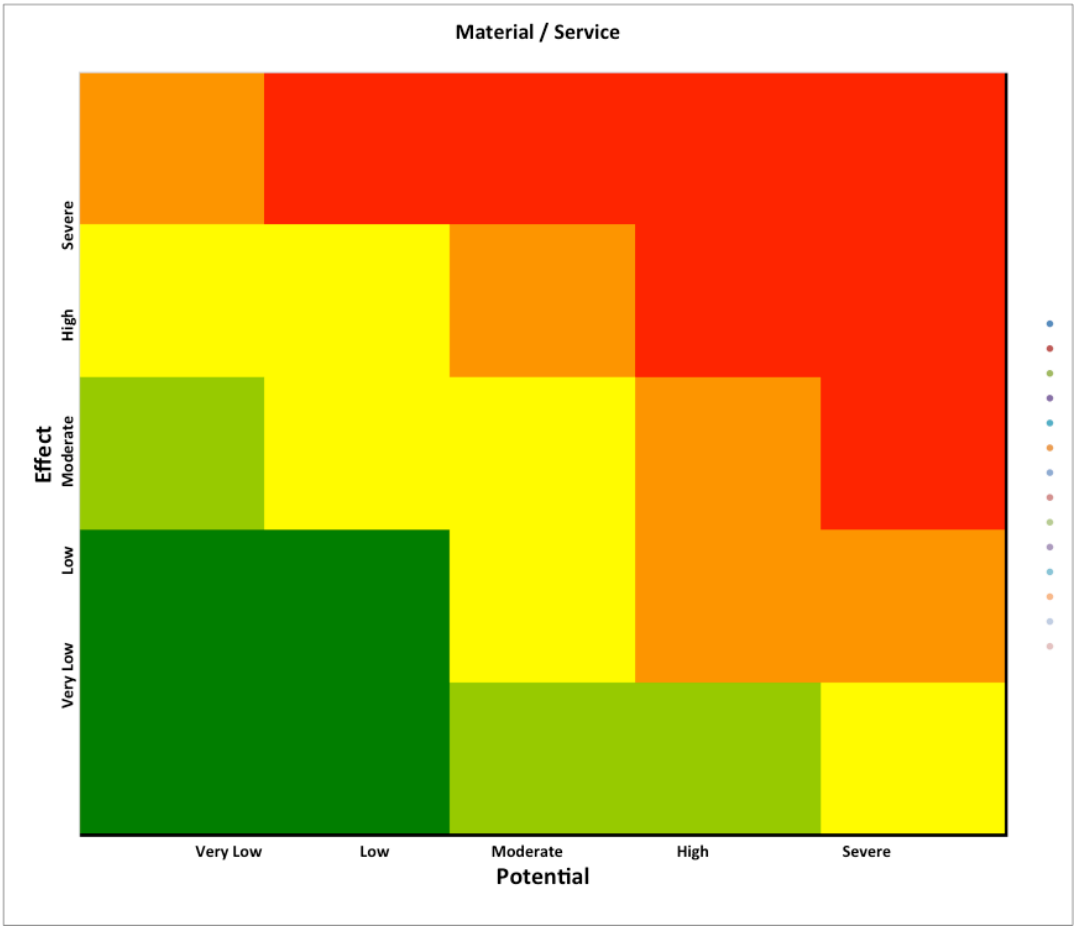
Appendix 11: Recommended strategies: short-term, medium-term, long-term

	Status	Already implemented	Short-term	Medium-term	Long-term	N/A
Hedging	x					x
Buy for Tier 1					x	
Study LME => Supplier buy when we decide	x					x
Contract			x			
Index in contract			x			
Back up / contingency						
Multi currency invoicing				x		
Supplier becomes a client	x					x
Review the need	x					x
Risk comities			x	x		
Skills				x		
RMI Tool (procurement prod, prices)			x		x	
Criticality level						
Action plans						
Supplier info intranet				x		
Tables						
Supply chain mapping			x	x		
Risk matrix						
Reconciliation report	x					x
Cost breakdown analysis				x		
Supplier screens			x			
Risk management process			x	x	x	

Appendix 12 - Procurement process and risk mitigation strategies - Metal Parts.



Appendix 13 – WestRock current risk matrix



Appendix 14 – Déclaration anti-plagiat - diffusion

DECLARATION ANTI-PLAGIAT

Ce travail est le fruit d'un travail personnel et constitue un document original. Je sais que prétendre être l'auteur d'un travail écrit par une autre personne est une pratique sévèrement sanctionnée par la loi.

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