LAPIN AMK

Lapland University of Applied Sciences

Development of costing tool for
Outokumpu Stainless Oy

Timo Saarela

FOREWORDS

First of all I would like to say the biggest thanks to my family, especially to my wife Jaana, who gave me opportunity to start, continue and complete these studies. Secondly, I have been lucky to have, in a row two managers in Outokumpu, who have given their full support for my studies, so thanks to Juha Orasvuo and Steve Hudson. I would also say greatest thanks to my thesis supervisor Timo Huhtala giving great guidance and support to succeed in this work.

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Last but not least I would say thanks to the great school of Lapland University of Applied Sciences. In this great university I had the opportunity to do my studies remotely and I was able to combine my studies with my work, hobbies and family.

Tornio on 9th of February, 2015

Timo Saarela

TIIVISTELMÄ

KEMI-TORNION AMMATTIKORKEAKOULU, Koulutusala

Koulutusohjelma: Tuotantotalous
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Toimeksiantonani oli kehittää uusi hinnoittelutyökalu Outokumpu Stainless Oy'n myynnin käyttöön. Hinnoittelutyökaluun liittyvät luottamukselliset tekstit ja asiakirjat on jätetty pois julkisesta opinnäytetyöstä. Opinnäytetyöni sisältää hinnoittelun ja kannattavuuden teoriaosuuden. Hinnoittelua ja kannattavuutta on tarkasteltu myynnin, tuotannon ja raaka-ainehankinnan näkökulmista. Teoriaosuudessa käsitellään mm. hintastrategiaa, hintapolitiikkaa, kontribuutiota, liikevoittoa ja hinnoittelun toimintaa käytännössä. Opinnäytetyöni sisältää myös teoriaosuuden regressioanalyysistä ja Outokumpu Oyj'n kannattavuuslaskennasta. Teoriaosuus hinnoittelusta ja kannattavuudesta toimii hyvänä taustamateriaalina kaikille yrityksen hinnoittelusta ja kannattavuudesta kiinnostuneille henkilöille. Opinnäytetyöni teoriaosuudessa keskitytään hinnoittelun ja kannattavuuden perusasioihin. Hinnoittelun ja kannattavuuden teoriaa selvitin lukemalla hinnoitteluun liittyviä kirjoja, hyödyntämällä internetiä ja Outokummun intranetiä. Toimeksiannon lopputuloksena syntyi uusi myynnin hinnoittelutyökalu ja se on nyt Outokumpu Stainless Oy'n käytössä.
Asiasanat: Opinnäytetyön sisällön perusteella valitaan 3 - 7 asiasanaa YSA:n eli yleisen suomalaisen asiasanaston mukaan. Sanat erotetaan toisistaan pilkulla.

ABSTRACT

KEMI-TORNIO UNIVERSITY OF APPLIED SCIENCES, Education

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This assignment was to review and develop existing costing tool for Outokumpu Stainless Oy. Confidential material of costing tool has been left out of the public thesis.   This thesis contains theory and empirical part of pricing and profitability, where theory is review on sales, production and raw-material purchasing point of view. Pricing and profitability theory contains; pricing strategy, pricing policy, contribution, operating profit and practical pricing. This thesis introduces basics of regression and Outokumpu Vertical Profitability System.   The theory section of thesis offers background material for all who are interested in company pricing. Details in Pricing, regression and vertical profitability theory stays on basic level. Main sources of the theory part were books and articles of them and finding information from Internet and company intranet.   As the result of the assignment, new developed costing tool was launched for Outokumpu Stainless Oy.
Asiasanat: Opinnäytetyön sisällön perusteella valitaan 3 - 7 asiasanaa YSA:n eli yleisen suomalaisen asiasanaston mukaan. Sanat erotetaan toisistaan pilkulla.

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USED SYMBOLS AND ABBREVIATIONS

AAF Alloy Adjustment Factor, Outokumpu name for Stainless steel alloy surcharge.

AS Alloy Surcharge. The Alloy surcharge is a price supplement calculated on the basis of the prices of alloying materials used by stainless steel producers (nickel, chromium and molybdenum), which is added to the basic price for stainless steel.

Base price Base price in stainless steel industry means price of stainless steel per tonne. It is agreed price and exclusive of alloy surcharges, Value Added Tax (VAT) and any other taxes or duties unless otherwise expressly agreed.

CC Initial of costing tool cost calculation.

LME London Metal Exchange. The London Metal Exchange is the world centre for the trading of industrial metals – more than 80% of all non-ferrous metal futures business is transacted on it platforms.

RM Initial of costing tool raw material calculation.

SQL Structured Query Language. SQL is a standardized language for defining and manipulating data in a relational database.

1 INTRODUCTION

Stainless Steel manufacturing business, together with almost all the industrial business especially in Europe is having challenging times. Stainless steel industry has met particular increase of competition during last five – six years. Together with economic crisis in Europe, Stainless steel industry gets new challengers from Asia, to compete with their customer. Increase of Asian imports on market has roiled the stainless steel markets in Europe. Especially Asian Stainless steel manufacturers are dumping the stainless steel material into Europe on very low prices.

Stainless steel has been strongly growing business in recent decades and, according to independent market researchers, growth will continue in future. In the past, stainless business was production constraint (i.e. demand was constantly exceeding the global stainless steel production capacity), thus natural focus in strategy was to get most out of mills and get production volumes high. Following recent, very strong Chinese players entry to the stainless markets after year 2000, in 2005 global production output of stainless steel was first time reported to exceed the global demand.

Nowadays the overcapacity is unsustainable for all players and Outokumpu is facing tough competition in all regions. Stainless steel producers are thus in tight price competition and racing to be more and more cost competitive in order to survive. In this market situation, in addition to get as much as possible volume sold, it is utmost important simultaneously to manage the prices at reasonable levels. In order to have clear view on bottom prices, it is vital to have updated view on current variable and fixed cost. That sets a requirement of very regularly updated review of raw-materials, freights and other cost elements per produced stainless steel grade.

Based on this challenging time in Stainless steel industry, Outokumpu Stainless Oy requires costing tool, which contains accurate information of company variable and fixed costs. This tool needs to deliver the best possible results for sales man to use, in order to win customers inquiry, by offering mutual satisfactory trading. In this thesis, this tool for Outokumpu Stainless Oy is introduced.

In addition to the costing tool this thesis contains pricing theory in chapter two, regression theory in chapter three. In chapter four there is introduction of Outokumpu corporate wide vertical profitability system. Vertical profitability system is introduced in this thesis since costing tool uses its cost data. Then in chapter five costing tool status and development are to be found. This chapter introduces current status and developed parts of costing tool. Chapter five contains introduction of business requirements and benefits, overview of this development requirements.

Chapter six explains details of this costing tool development deliverables. Chapter six introduces also costing tool interface and its changes on this development. Here we can also see how end user selections will work in new tool and how the end user selections impact costing tool results. There is also introduction of added production grades and as well as how raw material and conversion cost models work. New regression model within fixed costs and the way how the regression models are transferred into costing tool calculation master are introduced. Last thing in chapter six is introduction of raw material cost formulas and freight model.

Chapter seven contains introduction of costing tool update process. Update process explains how costing tool background data like raw material and conversion cost models are updated. In addition, there is introduction of freight model update and how input data is evaluated are to be seen. Chapter eight contains other activities like testing and training of the tool.

2 PRICING THEORY

2.1 Background

Immediately after the end of World War II there has been downward pressure on all the prices going too high. Some of its roots come from trade cyclical factors – such as slow economic growth in the Western economies and Japan – that have steered in consumer spending. There are newer sources as well: the huge increased purchasing power of retailers, such a Wal-Mart, which can therefore pressure suppliers; the internet, which adds to the transparency of markets by making it easier to compare prices; and role of China and other burgeoning industrial powers whose low labor costs have driven down prices for manufactured goods. The one-two punch of trade cycles and newer factors had weared corporate pricing power and forced frustrated managers to look in every direction for ways to hold the line. (McKinsey & Company 2014)

In such a business environment, managers might think that it's mad to talk about raising prices. We are not talking about raising prices across the board, but the most effective path is to get prices right for one customer or customer group, one sales transaction at a time, and to capture more of the price that you already charge. In this sense there is room for price increases or at least price solidity even in our current difficult markets. Such an approach to pricing, like transaction pricing, one of the three levels of price management, was first described and introduced about ten years ago. The idea was to figure out the real price you charged customers after accounting for a host of discounts, allowances, rebate, and other deductions. Only then you are able to calculate how much money, if any, you were making and whether you were charging the right price for each customer and transaction. (McKinsey & Company 2014)

Patented technologies often can be rapidly copied, and attempts to achieve breakthrough innovations often fail. What's left as a basis for competition is execution and smart decision making. Sophisticated analytics enable market leading companies to generate a new and lasting competitive advantage. This is the way how building and implementing analytical tool would create competitive differentiation. (Davenport & Harris 2007, 47)

There are several ways to approach competitive advantage on pricing by using data. One approach on pricing analytics is to collect unique data and prospects of customers over time. Collected data and prospects should be unique, so competitor cannot match or copy. Another way is to organize, standardize and even manipulate the data and as result data is in unique format. There is also option for companies to establish own algorithm what can give better and more insightful analyses for pricing decisions. Regardless of the analytical approach, companies needs to get competitive advantage of their analyses. Analytics need to be attached judiciously, them needs to be well executed and continuously reformed. (Davenport & Harris 2007, 48)

Companies who have successful compete on analytical skills, should have one of the following four capabilities. (Davenport & Harris 2007, 48)

1. Hard to duplicate. It's easy for companies to copy another company IT applications or its products and product related attributes. Quite another thing is to copy another company processes and their culture. (Davenport & Harris 2007, 48)

2. Unique. There is no one correct way to follow to be an analytical competitor. Company need to define their unique way of using analytics and their path should follow and support defined strategy and market position. (Davenport & Harris 2007, 48)

3. Adaptable for many situations. An analytical organization can apply and use analytical availability in different, innovative ways. (Davenport & Harris 2007, 48)

4. Better than competition. Even the company in different industries has analytical skills and their consolidated data is wide and accurate, some of companies are just better to utilize data than others. (Davenport & Harris 2007, 48)

2.2 Pricing three levels

Transaction pricing is introduced as one of the three levels of price management. Although to clarify, each level of these pricing levels is related to the other pricing levels. Secondly pricing action as any on level could easily affect the others as well. Businesses trying to provide a price benefit to make manager pricing a source of differentiate performance. This can be master of all the three of these levels. (McKinsey & Company 2014)

The widest view of pricing comes from industry price level, where managers must understand how to supply, demand, understand the costs, regulations and other high-level factors, how they impact on overall prices. Companies which apply this level of pricing could avoid unnecessary downward pressure of prices and often become as industry price leaders. (McKinsey & Company 2014)

The main issue on second level of pricing is a product and/or service, which is relative to the competition or competitor products and/or services. To make this happen, companies must understand how customers understands all offerings on the market and especially, which part of product as well as service(s) and nonmaterial goods attributes drive(s) for purchase decisions. Within this knowledge, companies can create their own price lists, which accurately impacts the competitive strengths (or weaknesses) of their offerings. (McKinsey & Company 2014)

Pricing third level, transactional level pricing, company needs to decide the exact price of each individual order or transaction separately. Starting point of this transactional pricing is the list of price and what discounts, allowances, payment terms, bonuses and other incentives should and must be applied or deduct. For majority of companies, the management of transaction pricing is the most detailed, time-consuming, system-intensive and energy intensive task involved to get the price advantage from market. (McKinsey & Company 2014)

2.3 Variable and fixed costs

Operating costs could be divided into variable or fixed production costs, with respect to volume. Both of terms refer for common view of total costs. There is a change in produced volume and this change has impact on amount of a particular costs element, and then this element of cost is variable cost. Variable costs are directly related to produce volume and they will increase if production volume increases. Example of variable costs is production raw materials, used energy in production, manning time on production. (Asish K. Bhattacharyya, pages 288 – 299)

A cost which does not change, even though the produced volume changes can be classified as fixed cost. There are business resources which need to operate whether there is production or not. There are three main categories which explain fixed costs:

1) Costs are stable on short period of time, typically a year (Excluding depreciation and other sunk costs)

2) Costs are stable even the production increases or decreases (for example: supervision)

3) Costs which are not directly related for production, for example design engineering.

Variable and fixed costs impact on unit cost can be illustrated in two ways. In picture 1 fixed cost is shown stable, but in the unit cost view on picture 2, the stable item is the line of variable costs. Fixed unit costs decreases per unit at each point of volume and fixed costs can ever be zero. Therefore the line on total costs in picture 2 takes the form of a hyperbolic curve. However, for most typical illustration of analytical view, variable and fixed costs are classified on the total, as shown in picture 1. (Asish K. Bhattacharyya, 288 – 299)
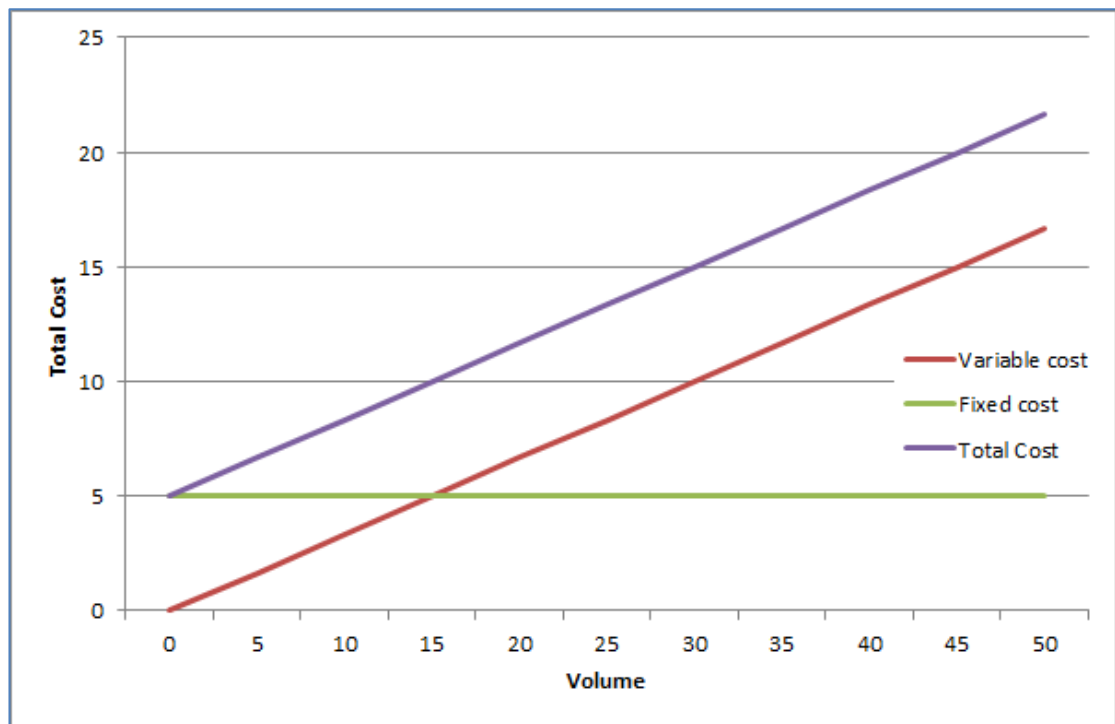
Picture 1: Graph of variable, fixed and total costs. (Asish K. Bhattacharyya, 288 – 299)

Cost classification into variable and fixed costs is only possible if the period of time, which these notions are related, is specified. If both costs are shown in relatively long period of time, in theory all the cost can be seen as variable costs. For most of the cases the used time period is generally a year or less. This definition is mandatory due to fact that cost variance studies needs to specify what facilities were used (e.g. material prices, wage rates, purchases). (Asish K. Bhattacharyya, 288 – 299)
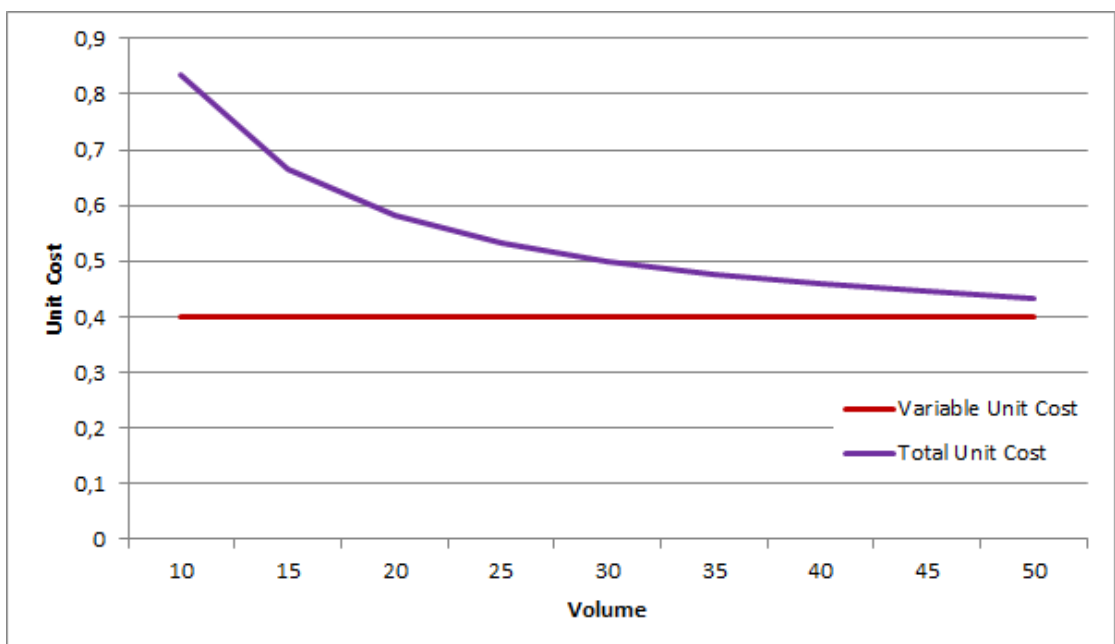
Picture 2: Graph of variable, fixed costs on a unit cost basis. (Asish K. Bhattacharyya, 288 – 299)

3 REGRESSION

Regression is a statistical event that occurs when repeated measures are made on the same subject or unit of sample(s). Regression happens due to fact that selected values are observed with occasional error. Occasional error means a non-methodical variation in the observed values around a true mean (e.g. occasional measurement error, or occasional flutter in a subject). Systematic error, where the observed values are consistently unilateral, is not the cause of regression. (Mongomery, Peck & Vining 2012, 12 - 21.)

Regression analysis involves identifying the relationship between a dependent variable and one or more independent variables. A model of the relationship is hypothesized and estimates that parameter values are used to develop a regression formula. Amount of data needs to applied into analyze, before model can be determined as valid model. If the model is found valid, the regression formula can be used to forecast the value of the dependent variable given values for the independent variables. (Mongomery, Peck & Vining 2012, 12 - 21.)

3.1 Simple regression model

In simple linear regression, the model is used to describe the relationship between a single dependent variable y and a single independent variable x is $y = a_0 + a_1x + k$. $a_{0 \text{ and}}$ a_1 are referred to as the model parameters, and is a probabilistic error term that accounts for the variability in y that cannot be explained by the linear relationship with x. If the error term were not present, the model would be deterministic; in that case, knowledge of the value of x would be sufficient to determine the value of y. (Mongomery, Peck & Vining 2012, 12 - 21.)

3.2 Multiple regression model

Multiple regression is model, which has two or more explanatory variables on the right side of the mathematical equation. Multiple regression should be used, if more than one cause is combined with the effect you wish to perceive. Multiple regression can give you visibility of more than one factor to make forecast. Comparing multiple regression for simple regression, it can give you results for only one factor. (Mongomery, Peck & Vining 2012, 12 - 21.)

When we are building regression analyze, it's crucial do define number of unknown parameters in the regression model. This process to bring parameters into model is called fitting the model for data. If you have several independent variables, like in costing tool, it is classical way to notate variables and the slope parameters like below:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p + error$$

3.3 Correlation

Correlation and regression analysis are related in the sense that both deal with relationships among variables. The correlation coefficient is a measure of linear association between two variables. Values of the correlation are always between -1 and +1. A correlation coefficient of +1 indicates that two variables are perfectly related in a positive linear sense. Correlation coefficient of -1 indicates that two variables are perfectly related in a negative linear sense. Correlation coefficient of 0 indicates that there is no linear relationship between the two variables. Correlation coefficient of $|c| < 0,5$ is not relevant. Correlation coefficient of $0,6 < |c| < 0,5$ would keep remarkable and Correlation coefficient of $|c| > 0,8$ is strong correlation (Thomas J. Archdeacon, 1994, 98 - 99.)

For simple linear regression, the sample correlation coefficient is the square root of the coefficient of determination, with the sign of the correlation coefficient being the same as the sign of b1, the coefficient of x1 in the estimated regression equation. (Thomas J. Archdeacon, 1994, 98 - 99.)

Neither regression nor correlation analyses can be interpreted as establishing cause-and-effect relationships. They can indicate only how or to what extent variables are associated with each other. The correlation coefficient measures only the degree of linear association between two variables. Any conclusions about a cause-and-effect relationship must be based on the judgment of the analyst. (Thomas J. Archdeacon, 1994, 98 - 99.)

4 COSTING TOOL STATUS AND DEVELOPMENT

In current market situation stainless steel industry suffers from global overcapacity. This puts pressure on market prices and leads companies to tight cost competition. Thus there is increasing need for knowing and impacting on company cost structure better than earlier. To improve cost awareness among sales people, previous version of costing tool was launched in the beginning of 2010. The aim was to improve the calculation processes, accuracy and rational behavior of variable and fixed cost levels. Stainless steel cost structure is heavily driven by direct raw material costs. Especially constantly changing nickel market price sets requirement for regularly updated information of costing tool.

Previous version of costing tool was built to fulfill increased requirements of cost information. Costing tool information was built multidimensional; it is updated regularly and it gives single point information of Outokumpu Stainless Oy cost. Outokumpu sales people could use costing tool to examine different profit break-even levels and make hard decisions on the tightest offers. Tool was mainly used by Outokumpu Stainless Oy sales. Costing tool was regularly used and highly appreciated among sales people and thus deserved its status in the sales people's toolkit.

4.1 Requirement for new tool

Case for change was to develop a new version of Outokumpu Stainless Oy costing tool. In practical terms, the requirement was further development of calculation procedures of the tool, planning and documenting updating process, remodeling calculation and interface and finally distribution and end-user training of the tool. In addition to this, governance of the tool was documented. Basic calculation principles of the tool were decided to keep unchanged but e.g. regression model was required to be reviewed and rebuilt aiming for higher correlation factor of the model. The aim was also to make the update process as lean and clear as possible.

The goal was to create a new version of the tool which offers a possibility to simulate an impact of key variables on operating profit level. The developed tool was also aiming at giving a better view of costs between product features and gauges. In the new costing tool, possibility to simulate metal market price change impacts to the profit / price levels was required to be kept.

New costing tool with frequent update will support sales people and will make their work more efficient. Without the information of the tool function, sales people need to gather similar information from several sources and perform several manual calculations to make decisions on their offers on daily basis. Manual process is a risk for faults and when there are many people making calculations, usually calculation principles are different and results multiple. With this tool, calculation principles are harmonized and data is readily available. In the development of the costing tool the aim was to re-build the costing tool, evaluate all the data inputs, implement validation and quality checks.

4.2 Business benefits

Outokumpu was able to recognise three different business benefits from this development. Firstly, the new tool gave full transparency to product cost structure. This work extended profitability levels from contribution down to operating profit. Developed costing tool reports the most recent costs and pre-calculates different profit level information for sales decision makers.

Secondly, the new tool provides better costs accuracy. All the tool calculations were reviewed and re-modelled, variable cost regression model resulting in higher correlation. Also new regression model for fixed cost was established.

Thirdly, the new tool requires less administration time. Lean and clear update process of the tool was successfully planned and created. New process model to validate data inputs and costing tool results was established and implemented together with help of raw-material purchase department. Freight costs updating process was established with logistics department who are accountable for maintaining company freight cost data.

Outokumpu costing tool variable (production) and fixed (production, sales & marketing, depreciation and general administration) costs utilises vertical profitability system cost information from last six months. Vertical profitability data is queried directly from Outokumpu data warehouse and contain costs from different production stages. Production stages are melting shop, hot rolling, cold rolling mill and finishing lines.

4.3 Linkages

Costing tool has several linkages to existing tools or business processes. These linkages are vertical profitability, metal market prices and currencies, freight costs and forecasting process of raw material prices.

4.3.1 Vertical profitability system

Since costing tool uses Outokumpu corporate wide profitability tool variable and conversion cost data, it is introduced in this thesis. In Outokumpu, we have corporate level "operative" information, i.e. financial data is reworked to better support our planning and decision making in the areas of sales, profitability and inventory management. Vertical profitability system purpose is simply to better understand the profitability from the value chain perspective and from the customer viewpoint rather than for internal businesses and the sales between them. It is intended to support better "operative" decision making, i.e. on such issues as pricing of stainless steel, capacity allocation, product, customer and market strategies, route-to-market planning etc. Capacity allocation means that Outokumpu reserve future production time for certain customer or product sequence. Vertical profitability system way of looking profitability is different than e.g Hyperion Financial management. Vertical profitability system differs from other views on profit as it could give the very detailed view of Outokumpu product line (invoiced order split into produced material packages) profitability. (Outokumpu Intranet, 2014)

Operative information in Outokumpu means that numbers are aligned to the decisions our personnel takes in the business (picture 3). For example, when we are looking at a customer's profitability, any change in raw material prices or exchange rates from when the order was taken will then be excluded from the order profit. This time adjusted raw material calculation method gives fair results for every sales order in system. Being corporate means that numbers cover all units, which are linked into vertical profitability system and are comparable, or harmonized, so that each reporting unit is treated with the same principles (this is not the case in Outokumpu's financial systems which differ from unit to unit and regionally). (Outokumpu Intranet, 2014)

In the Vertical profitability system Outokumpu can measure the profit created from all of our sales, in all production stages from melting, hot rolling, cold rolling, finishing, packing the material and till customer delivery. Vertical profitability system is very important for Outokumpu as we are steering the company into stable profitability. Instead of looking at business location by location, vertical profitability system helps by identifying the profit created by our external customers. Vertical profitability looks profitability from our external customer perspective and calculates cost route, where material was melted, where it was rolled, finished and packaged. All previous stages could be produced in different locations, where vertical profitability system can recognize them and allocate each steps cost into profitability calculation. Vertical profitability system gives Outokumpu vies of for example the most profitable segments and customers to sell to. It also helps identifying the best products and routes to market (from melting mill till customer) to serve the customers. (Outokumpu Intranet, 2014)
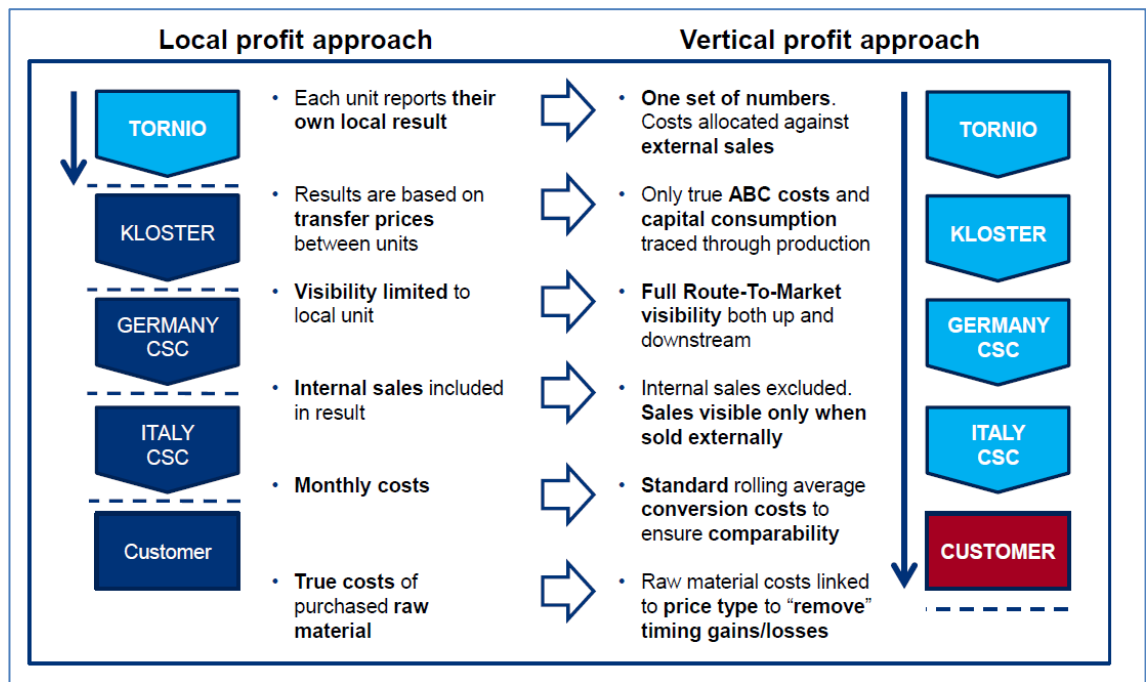
Picture 3: Local and vertical profit approach.

Taking transfer prices (material internally sold e.g from Tornio to Italy service center) out of our numbers allows us to see the real profitability of our sales. We can identify vertically profitable sales that are profitable for whole Outokumpu Group. This helps us to sell more volume, more profitably. Because vertical profitability system also reports each sale from over 30 different perspectives, such as customer, route-to-market, grade, finish, thickness, price type, we can also drill down in our sales history and see which part of a customer's sales portfolio performs well and which does not. This is where vertical profitability supports us making right decisions for our business. (Outokumpu Intranet, 2014)

4.3.2 Metal market prices and currencies

Outokumpu raw material costs are determined based on public metal alloy market prices. Depending on purchasing contracts and raw material type (scrap or primary material) the final prices of raw materials are agreed between Outokumpu and individual supplier. Thus costing tool requires metal market price and more detailed contract information as an input. The main alloys are nickel, chromium, molybdenum, iron, copper, titanium, manganese and niobium. Metal market quotations used for the metals are listed below. Since metal quotations are US dollar based and costing tool results are in euros, also USD/EUR exchange rates are required. Costing tool utilizes existing process of metal market and currency data input into Outokumpu data warehouse metal prices and currencies (MPC). Metal market and currency data is delivered by Bloomberg.

- Nickel. Nickel is the LME Official Price is the last bid and offer price quoted during the second Ring session. (London Metal Exchange, 2014)

- Iron $ per Tonne. Iron quotation is published by Metal Bulletin. (Metal Bulletin, 2014)

- Ferro-chrome Lumpy CR charge basis 52% Cr quarterly major European destinations $ per lb Cr. The settlement of Ferro-chrome is negotiated every quarter by a large South African ferro-chrome producer and a large European consumer and has in recent quarters been settled by ferro-chrome producer Glencore Xstrata and Luxembourg-based stainless steel mill Aperam. (Metal Bulletin, 2014)

- Molybdenum. Quotation is published by Metal Bulletin. (Metal Bulletin, 2014)

- Copper. Copper is LME Official Settlement Price is the last offer price quoted during the second Ring session. Quotation is published by Metal Bulletin. (Metal Bulletin, 2014)

- Titanium. Quotation is published by Metal Bulletin. (Metal Bulleting, 2014)

- Manganese. Quotation is published by Metal Bulletin. (Metal Bulleting, 2014)

- EUR/USD. *The reference rate is based on a regular daily concentration procedure between central banks across Europe and worldwide, which normally takes place at 2.15 p.m. CET.* (European Central Bank, 2014)

4.3.3 Freights

Outokumpu Stainless Logistics department is responsible of company stainless material invoicing and accountable to arrange stainless material deliveries from Tornio mill to internal or external customer. Logistics department is responsible for negotiation of freight costs with transport service suppliers and maintaining of the latest freight cost information. The department updates the latest contracts into local bookkeeping.

Outokumpu Stainless IT collects and consolidates company internal data into local data warehouse, which includes also freight costs data. This consolidated freight cost data is then used in costing tool, which shows freight cost per country and per delivery type.

4.3.4 Forecasted raw material prices

Recent metal market prices from the sources described above are used for estimating profitability of day to day type of short term deals. For long term (above three months in future) contracts' profitability estimation, costing tool requires future prices of nickel alloy. Nickel future values are quoted by London Metal Exchange (LME). Costing tool utilizes existing process of getting future values of nickel, which has existed due to the hedging requirement of the metal risk. There was an intention to get all the future prices of alloys into the costing tool but at the time of writing this thesis, process of getting the values was not completed.

4.4 Development limitations

Outokumpu is worldwide stainless steel giant company with multiple locations. In the scope definition phase, extension of the costing tool to cover more units was discussed. However the decision was made to keep the work focused and re-build costing tool only for Outokumpu Stainless Oy (located in Tornio).

4.5 Schedule

Development of costing tool had following schedule as on table 1:

Table 1: Costing tool development schedule.

ID	Item	June	July	August	September
1.	Development plan and technical readyness	██			
2.	Test case and testing of tool		██		
3.	Testing results			██	
4.	Implementation and training of the tool				██

4.6 Budget and resources

The work was done by internal resources. Management Information Team which belongs to Controllers Corporate Office carried the general meeting costs. Any development activity outside these activities, such as travelling costs was carried by home units. The planned budget was kept.

5 DEVELOPMENT DELIVERABLES

Outokumpu Stainless Costing tool development can be split into four main categories. First category, costing tool development contains: interface, raw material costing model, conversion costing model and freight model. Second category, costing tool update process contains: raw material cost model update, conversion cost model update, and freight cost model update and validation process planning and implementation. Validation process planning and implementation deliverable contains; validation of input data, validation of raw material cost output together with raw material purchase function, validation of conversion costs and validation of freight costs together with logistics (table 2).

Third category, documentation of tool contains; interface documentation, documentation of RM costs calculation principles, documentation of conversion cost calculation principles, documentation of tool update process and documentation of data validation process. Fourth category, user identification and training contains; user identification and access, end user training material, administration training material and training schedule and implementation.
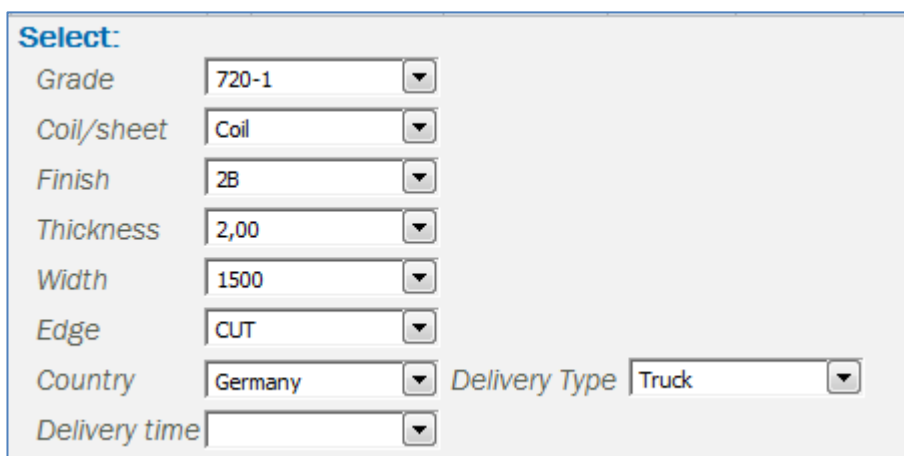
Table 2: Costing tool development deliverables and their schedule

ID	Item	Schedule Original	Change Owner / Approver	Business Sponsor / Approver
1.	Costing tool 2.0 development	31-Jul	Timo H	Hannu L
1.1	Interface	31-Jul	Timo H	Hannu L
1.1.1	Extend profitability levels	31-Jul	Timo H	Hannu L
1.1.2	Apply colouring into results, depending user input. Validity of tool	31-Jul	Timo H	Hannu L
1.2	Raw material costing model	31-Jul	Timo H	Hannu L
1.2.1	1.2.1. Add raw material future values	31-Jul	Timo H	Hannu L
1.2.2	1.2.2 Modify RM calculation sheet flexible for inserting new grades	31-Jul	Timo H	Hannu L
1.3	Conversion cost model	31-Jul	Timo H	Hannu L
1.3.1	New regression model for variable costs	31-Jul	Timo H	Hannu L
1.3.2	Regression model for fixed costs	31-Jul	Timo H	Hannu L
1.3.3	Move regression model into calculation master	31-Jul	Timo H	Hannu L
1.3.4	Create conversion costs formulas only for end user version	31-Jul	Timo H	Hannu L
1.3.6	Modify CC calculation sheet flexible for inserting new grades	31-Jul	Timo H	Hannu L
1.4	Freight model	31-Jul	Timo H	Hannu L
1.4.1	New freight costs updating process	31-Jul	Timo H	Hannu L
2.	Pre-Costing Tool Update process	31-Aug	Timo H	Hannu L
2.1	Raw material cost model update	31-Aug	Timo H	Hannu L
2.2	Conversion cost model update	31-Aug	Timo H	Hannu L
2.3	Freight cost model update	31-Aug	Timo H	Hannu L
2.4	Validation process planning and implementation	31-Aug	Timo H	Hannu L
2.4.1	Validation of input data	31-Aug	Timo H	Hannu L
2.4.2	Validation of conversion costs	31-Aug	Timo H	Hannu L
2.4.3	Validation of freight costs together with logistics	31-Aug	Timo H	Hannu L
3.	Documentation of tool	30-Sep	Timo H	Hannu L
3.1	Interface documentation	30-Sep	Timo H	Hannu L
3.2	Documentation of RM cost calculation principles	30-Sep	Timo H	Hannu L
3.3	Documentation of conversion cost calculation principles	30-Sep	Timo H	Hannu L
3.4	Documentation of tool update process	30-Sep	Timo H	Hannu L
3.5	Documentation of data validation process	30-Sep	Timo H	Hannu L
4.	User identification and training	31-Oct	Timo H	Hannu L
4.1	User identification and access	31-Oct	Timo H	Hannu L
4.2	Create end user training material	31-Oct	Timo H	Hannu L
4.3	Create tool administration training material	31-Oct	Timo H	Hannu L
4.4	Training schedule and implementation	31-Oct	Timo H	Hannu L

5.1 Interface

5.1.1 End user selections

Costing tool end user interface contains nine drop-down menus (picture 4). First drop-down menu for Polarit grade. Then five drop-down menus for finished product dimensions, which are split for coil and sheet, finish, thickness, width and edge. Last three drop-down menus contain material transportation related items, where end user could select country of delivery and delivery type. Last selection is delivery time, where end user could select offered confirmed delivery month.
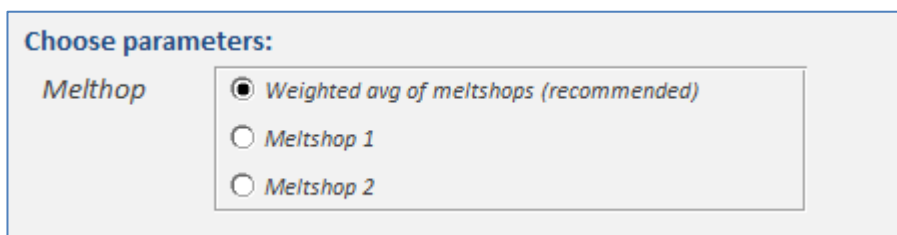
Picture 4: Costing tool pull-down lists

Costing tool has also couple of more parameters for end user to select. First selection defines which melt shop based costs user want to see. In practice (picture 5), end user can impact the production line, by choosing either melt shop one or melt shop two. By default, without any selection, costing tool will use weighted average of melt shops costs in calculation.

Picture 5: Costing tool melting shop options

User is also able to change raw material price parameters in the tool (picture 6). By default, costing tool will use the latest updated (last five day average) raw material values. For the benefit of the end user tool offers option to review the impact on costing tool results by changing raw material prices. Raw material quotations in the tool are in US dollars.

Nickel	☑ Last 5d avg	15 952	or value		USD/t
Chrome	☑ Last 5d avg	1,18	or value		USD/lb
Molybdenum	☑ Last 5d avg	25,64	or value		USD/kg
Iron	☑ Last 5d avg	387	or value		USD/t
USD/EUR	☑ Last 5d avg	1,377	or value		USD/EUı
*last quotation 28.3.2014					

Picture 6: Costing tool raw material options

In the input section user can type the price and credit days of offered stainless steel material (picture 7). Price of an offer can be entered either in US dollars or in euros.

Your offer:

Price	2 200		● EUR/t ○ USD/t
Credit days	60	Days	

Picture 7: Costing tool offer options

5.1.2 Results

Costing tool results show view of profit and loss statement up to operating profit level (picture 8). Line items of the statement are aggregates and as follows: sales price, raw material cost, spread, freight cost, variable production cost, contribution, fixed production cost and depreciation, gross profit, sales and marketing, general and administration and other cost and operating profit. As additional information costing tool displays also cost of credit.

Costing tool interface includes bar chart which visualizes the results (picture 9). Bar chart shows sales offers bar on green if offered value results is positive in each profit level. Else offered bar will be shown as red.

Costing tool results are shown in euros per tonne or in US dollars per tonne. End user has option to adjust the different cost items of the offer to ensure that potential special items in the offer are taking in to account. Adjusted costs are requested to apply in euros.

Results:

	EUR/t	Adj. EUR/T	USD/t
Sales Price			
Raw material cost			
Spread (xx %)			
Freight cost			
Variable prod. cost			
Contribution (xx %)			
Fixed prod. + depr. cost			
Gross Profit (xx %)			
S&M, G&A + other cost			
Operating Profit (xx %)			
Cost of credit			

Picture 8: Costing tool results data

Picture 9: Costing tool results graph – tee dummy

5.2 Raw material costing model

Raw material cost calculation is mathematical formula, which takes into account alloy contents of different grades, metal market prices, scrap mixes, contract specific items in raw material batch pricing and process specific yield. For day to day business (short term deals) last five days averages of raw materials and currency exchange rates are used. As stated in the previous chapter for the long term contract profitability evaluations future value of the nickel is used.

Raw material cost calculation inputs are as follows:

Scrap mixes (table 3):

- Polarit grades (Outokumpu Stainless Oy specific stainless steel codes).

- Period displaying year and month when scrap mixes are valid.

- Scrap mix for ferrochrome on melting line one and two

- Scrap mix for nickel on melting line one and two

- Scrap mix for ferromolybdenum on melting line one and two

Table 3: Melting shops line 1 and line 2 scrap mixes

Grade	Period	MS line 1				MS line 2			
		ScMix Cr	ScMix Ni	ScMix Mo	Free Iron	ScMix Cr	ScMix Ni	ScMix Mo	Free Iron
710-1	201 409	X	X	X	X	X	X	X	X
710-2	201 409	X	X	X	X	X	X	X	X
710-3	201 409	X	X	X	X	X	X	X	X
711-1	201 409	X	X	X	X	X	X	X	X
711-2	201 409	X	X	X	X	X	X	X	X
720-1	201 409	X	X	X	X	X	X	X	X
720-4	201 409	X	X	X	X	X	X	X	X
725-1	201 409	X	X	X	X	X	X	X	X
725-8	201 409	X	X	X	X	X	X	X	X
731-1	201 409	X	X	X	X	X	X	X	X
735-1	201 409	X	X	X	X	X	X	X	X
743-1	201 409	X	X	X	X	X	X	X	X
750-2	201 409	X	X	X	X	X	X	X	X
757-1	201 409	X	X	X	X	X	X	X	X
761-1	201 409	X	X	X	X	X	X	X	X
781-1	201 409	X	X	X	X	X	X	X	X
810-1	201 409	X	X	X	X	X	X	X	X
811-1	201 409	X	X	X	X	X	X	X	X
812-1	201 409	X	X	X	X	X	X	X	X
816-1	201 409	X	X	X	X	X	X	X	X
822-1	201 409	X	X	X	X	X	X	X	X
850-1	201 409	X	X	X	X	X	X	X	X
850-2	201 409	X	X	X	X	X	X	X	X
853-1	201 409	X	X	X	X	X	X	X	X

Contract specific items (table 4) containing:

- Period displaying year and month when melting shops

- Ferrochrome price in prime

- Ferrochrome price in scrap

- Nickel price in scrap

- Ferromolybdenum price in scrap

- Ferromolybdenum price in prime

Table 4: Contract specific items

Period	Cr price in Prime	Cr price in scrap	Ni price in scrap	Mo price in scrap	Mo price in prime
201 409	X	X	X	X	X

Chemical compositions of Stainless steel grades (table 5):

- Polarit grade (Outokumpu Stainless Oy specific stainless steel codes)

- Chemical compositions of ferrochrome (Cr), nickel (Ni), ferromolybdenum (Mo), titanium (Ti), copper (Cu), manganese (Mn), niobium (Nb) and iron (Fe).

    Values in table show receipt of stainless steel grade per each alloy.

Table 5: Chemical compositions of Stainless steel grades

| Grade	Cr	Ni	Mo	Ti	Cu	Mn	Nb	Fe
710-1	X	X	X	X	X	X	X	X
710-2	X	X	X	X	X	X	X	X
710-3	X	X	X	X	X	X	X	X
711-1	X	X	X	X	X	X	X	X
711-2	X	X	X	X	X	X	X	X
720-1	X	X	X	X	X	X	X	X
720-4	X	X	X	X	X	X	X	X
725-1	X	X	X	X	X	X	X	X
725-8	X	X	X	X	X	X	X	X
731-1	X	X	X	X	X	X	X	X
735-1	X	X	X	X	X	X	X	X
743-1	X	X	X	X	X	X	X	X
750-2	X	X	X	X	X	X	X	X
757-1	X	X	X	X	X	X	X	X
761-1	X	X	X	X	X	X	X	X
781-1	X	X	X	X	X	X	X	X
810-1	X	X	X	X	X	X	X	X
811-1	X	X	X	X	X	X	X	X
812-1	X	X	X	X	X	X	X	X
816-1	X	X	X	X	X	X	X	X
822-1	X	X	X	X	X	X	X	X
850-1	X	X	X	X	X	X	X	X
850-2	X	X	X	X	X	X	X	X
853-1	X	X	X	X	X	X	X	X

5.3 Conversion cost model

Due to high diversity of stainless steel end products, production costs are affected by many more than one or two variables. After careful investigation of the raw conversion cost data combined with the qualitative knowledge of the industry and iteration of the regression models, six main variables were selected originally to the group of explanatory variables. Those variables were: thickness, grade, finish, width, shape and edge.

After further study done in this thesis, contrary to the previous version of costing tool, yield was decided to drop-out from the variables as it has no or only small impact on correlation coefficient. Also, the original need of providing possibility to play with yield of new products (when costing tool was originally launched) was not any more valid. Conversion cost model consists of two separate multiple regression calculations and one heavily standardized packaging costs. Multiple regressions are separately built for variable and fixed production costs (the latter including production depreciation).

In this model, thickness is only numerical variable, where others are counted as "dummy" variables. When production cost variables were evaluated, finding was that cost of thickness is exponentially increased, when material is rolled from thick to thinner. Since used regression model is linear and thickness impact on cost was exponential, there was need for normalizing thickness values. In this model thickness is normalized by applying natural logarithm for actual production thicknesses (picture 10).

Chosen set of cost is another boundary value in end user tool point. Chosen set of costs are same as offered options for end users to view different variables impact for spread, contribution, gross profit and operating profit. In end user version there is also drop-down menu for freight and credit costs.
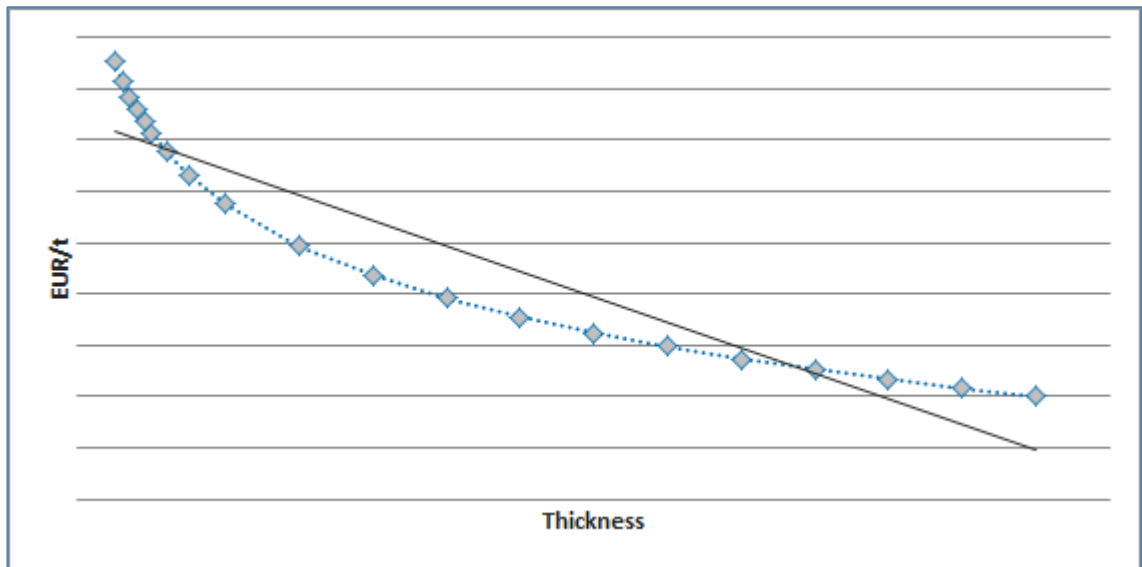
Picture 10: Natural logarithm of actual thickness

5.3 Regression model for fixed cost

Fixed production cost gives information of production unchanged fixed cost, which will be stable even there is no production. Fixed production cost contains changes when offered product material gauges changes. Fixed costs contains production, sales & marketing, depreciation and all the general administration costs from melting shop, hot rolling – and cold rolling mill.

By applying production and administration fixed costs, end user can get results of gross- and operating profit. Added fixed cost will give information for end user, what would be gained gross- and operating profit, when they are making their offers for customer. At the offer point it's crucial to understand how, even the minor change for offer, could impact our company profitability.

5.4 Regression models into calculation master

Costing tool contains business sensitive confidential information. Previous version of the tool contained different calculation spreadsheets for raw material costs, conversion costs and freight costs. There was obvious risk that confidential calculation data and calculation procedures of the costing tool could leak into wrong hands. In the planning phase of the costing tool deliverables, one of the highest priorities was to improve data security of the confidential information. The decision was taken to transfer all the possible calculation procedures outside the user interface. Calculation master file was established and only the relevant information was transferred back to end user tool.

5.5 Sensitives of conversion costs

Sensitives for different product gauges are included as additional information for the costing tool users. The purpose of the sensitivity information is two-folded. On one hand sensitivity information increases end-users' awareness of production costs of different products. On the other hand, sensitivity information increases end-users' awareness of cost item change impact for variable costs. Variable costs sensitives are calculated for thickness, grade, finish, width, shape and edge. Sensitivity cost information contain also raw material sensitivity matrix for raw material cost of chosen grade in relation to nickel and chrome price changes.

5.5.1 Thickness

Thicknesses are divided into twenty different thickness groups. Thickness group on thick end is rounded into integer of millimeter, where thickness group on thin end has groups in every 0,1 millimeter. Thickness groups start from 0,50 mm and end on 13,00 mm. On costing tool regression model these thickness groups are not used, but regression model includes in all the actual thicknesses (adjusted by natural logarithm).

Production costs increase exponentially when product is rolled thinner. Example: on 10.00 mm thick material production costs are 8 €/tonne higher than 13.00 mm material. At same time, if material thickness is changed from 2.00 millimeter into 1,50 the production cost will increase 9 €/tonne, even the reduction is 1/6 from previous (table 6). Since production costs increases exponentially when product is rolled thinner, in costing tool regression thickness is normalized by using natural logarithm. Using natural logarithm on thickness will give higher correlation in costing tool regression model.

Table 6: Variable production cost sensitives of Thickness

Thickness	Change	Cum. change
5,00	X	X
4,00	X	X
3,00	X	X
2,00	X	X
1,50	X	X

5.5.2 Grade

Grades are divided into three grade groups. First grade group, grade group 1 contains grades; 711-1, 711-2, 731-1 and 735-2. Second grade group, grade group 2 contains grades; 720-1, 725-1, 750-2, 757-1. Third grade group, grade group 3 contains grades; 810-1, 811-1, 812-1, 816-1, 850-1, 850-2. The purpose of grade grouping is to simplify and reduce variables on regression model. Grade group 2 has lowest production cost and sensitives table shows that e.g. change from into austenitic group would increase the production costs approximately 30€ per tonne (table 7).

Table 7: Variable production cost sensitives of Grade

Grade	Change	Cum. change
Grade group 1	X	X
Grade group 2	X	X
Grade group 3	X	X

5.5.3 Finish

Standard mill finishes and mechanically treated surface finishes of appropriate hot and cold rolled stainless steels are given in EN 10088 Part 2 in which the designations for surface finishes are given by number, for example, 1 for hot rolled, 2 for cold rolled, and classified by a combination of number and letter as 2J. This system provides basic information on process route and description. (Euro Inox, 2014)

Different finishes are divided into three finish groups. First group contains hot rolled (1D) finishes, second group contains hot rolled material produced by using cold rolled tolerances (2E) and third group contains typical cold rolled finish (2B). Finish group 1D has lowest production cost and sensitives table shows that change from 1D into 2B would increase the production costs approximately 36€ per tonne (table 8). Finishes are combined into three different groups in order to offer simplified review of finish change impact on production cost. The purpose of finish grouping is also to simplify and reduce variables on regression model.

Table 8: Variable production cost sensitives of Finish

Finish	Change	Cum. change
2E	X	X
1D	X	X
2B	X	X

5.5.4 Width

Width is divided into three width groups. First group contains 1500 mm wide, second group contains 1250 wide and third group contains 1000 mm wide material.

Widths are combined into three different groups in order to offer simplified review of width change impact on production cost. Width group 1500 has lowest production cost and sensitives table shows that change from 1500 into 1000 would increase the production costs 5€ per tonne (table 9). The purpose of width grouping is to simplify and reduce variables on regression model.

Table 9: Variable production cost sensitives of Width

Width	Change	Cum. change
1500	X	X
1250	X	X
1000	X	X

5.5.5 Shape

Shape is divided into two shape groups. First group contains coil and second group contains sheet material.

Shape is combined into two different groups in order to offer simplified review of shape change impact on production cost. On shape group costing tool do not take account length of material. Shape group coil has lowest production cost and sensitives table shows that change from coil into sheet would increase the production costs 13€ per tonne (table 10). The purpose of shape grouping is to simplify and reduce variables on regression model.

Table 10: Variable production cost sensitives of Shape

Shape	Change	Cum. change
Coil	X	X
Sheet	X	X

5.5.6 Edge

Edge is divided into two edge groups. First group contains mill and second group contains cut material.

Edge is combined into two different groups in order to offer simplified review of edge change impact on production cost. Edge group mill has lowest production cost and sensitives table shows that change from mill into cut would increase the production costs 10€ per tonne (table 11). The purpose of edge grouping is to simplify and reduce variables on regression model.

Table 11: Variable production cost sensitives of Edge

Edge	Change	Cum. change
MILL	X	X
CUT	X	X

5.5.7 Nickel and Chrome

Sensitivity shows impact of nickel and chrome changes on raw material costs.

On example table, if raw material Nickel notification increases in 1000 $/tonne, it would increase nickel content grade 720-1 variable costs at X € / tonne (table 12).

Table 12: Variable production cost sensitives of Nickel vs. Chrome

Selected Grade	720-1	RM cost change in EUR/t by Ni and Cr price sensitives								
		Ni Price change $/tonne								
		-4000	-3000	-2000	-1000	0	1000	2000	3000	4000
Cr Price change ($/lb)	-0,20	X	X	X	X	X	X	X	X	X
	-0,15	X	X	X	X	X	X	X	X	X
	-0,10	X	X	X	X	X	X	X	X	X
	-0,05	X	X	X	X	X	X	X	X	X
	0,00	X	X	X	X	X	X	X	X	X
	0,05	X	X	X	X	X	X	X	X	X
	0,10	X	X	X	X	X	X	X	X	X
	0,15	X	X	X	X	X	X	X	X	X
	0,20	X	X	X	X	X	X	X	X	X

5.6 Evaluation of conversion cost results

As expressed above, variable production costs and fixed production and depreciation costs are modelled using multiple regression modelling functionality of Microsoft excel program. In theory of regression modelling, there are many ways to evaluate the goodness of the results. For avoiding to drilling down to all the evaluation measures the most important evaluation factor, correlation co-efficient was used in the result evaluation. Referring to the theory section if the correlation coefficient is below 50 percent, correlation is poor. If it is between 60 and 80 percent, correlation is good. If the factor is above 80 percent, correlation is strong.

Obvious aim was to get costing tool conversion costs regression models correlation coefficient as high as possible. In variable regression model, 64 percent coefficient was achieved. In the fixed and depreciation production costs, correlation coefficient was higher at 73 percent.

As discussed above number of variables in regression model was restricted intentionally in one hand to keep the model lean and understandable and on the other hand due to limitations of Microsoft excel program. Accuracy of the model can be increased by adding number of variables or cleaning the source data. Recommendation for further development of the model is to improve validation process of the source data and understanding of the regression model's sensitiveness for deviant values. Potential areas of validation process improvement are automatizing of the source data checking or building the data checks for the calculation process in order to avoid human or systematic errors. By investigating the deviant values of the source data outliers can be recognized and further analyzed is there natural reason for deviation of data.

5.7 Freight model

In the previous version of the costing tool freight costs were based on last known quarter actual freights. The aim in the costing tool development was to apply agreed future values of freights into costing tool. However, in meeting with Outokumpu Stainless Oy logistics, we agreed that latest known actuals are continued to be used as freight values. It was also agreed that new freight data evaluation process will be established. You can find own chapter of the freight data evaluation from this thesis (chapter 6.4).

Outokumpu Stainless Oy logistics gave strong recommendation, that costing tool user should not be able to select transport mode in the tool. According to them there is high risk to misinterpret our freight cost by choosing e.g. lower cost container rather than truck. Despite the recommendation it was decided that optional choice of transport mode remains in the tool. Costing tool default choice, average cost of transport mode is added as a default choice for tool. Additionally in the meeting with logistics was agreed that optional choice of open top container needs to be applied into transport modes. (Untinen & Knuuti & Pitko 2014)

6 UPDATE PROCESS

Update process of the current and developed costing tool is unchanged in principle. However the documentation of the update process was updated. As previously costing tool is updated and sent to end users regularly. Data for costing tool is updated according to costing tool schedule.

6.1 Raw material and currency exchange rate update process

After raw material and currency exchange rate of USD has been updated, costing tool administrator will review updated data and compare against previous weeks' data, in case there are possible update errors in data. If errors are not found, new raw material data is replaced to the model. After costing tool is updated, administrator sends updated costing tool for end users via e-mail. In the new version of the tool, both actions of raw material updates and e-mail sending is automated, by using excel macros. E-mail is sent to costing tool administrator, where then forwarded to end user.

6.2 Raw material cost model update

On agreed schedule costing tool raw material cost model needs to be updated. Costing tool administrator will update melting shops scrap mixes and melting shops production volume. This update is done by using structured query language (SQL) query and data is picked up from Vertical Profitability System.

On agreed schedule basis, costing tool administrator will send request for raw material purchasing and ask data for raw material prices in prime and scrap. Raw material purchase person will collect, evaluate and reply data via e-mail back to costing tool administrator. On this development we agreed that costing tool updates of raw materials are evaluated by raw material purchase.

6.3 Conversion cost model update

After vertical profitability closing process, costing tool administrator will update costing tool variable, fixed and other costs regression data. Regression update is done by using sql query and data is picked up from Vertical Profitability system.

Costing tool administrator will review updated data and compare it earlier data, if there is possible update errors of data. If errors have not been founded, administrator will update regressions into user version and then on next update of costing tool, these updated regression data will be used.

6.4 Freight cost model update

Earlier costing tool freight data was taken from Outokumpu Stainless Oy local reporting tool, where there was no agreed validation process to find whether the agreed periodical freights were accurate for costing tool. On this development we agreed that administrator or costing tool will follow freight data evaluation process.

Freight data will be updated into costing tool based on agreed schedule. Historical data of freights will be used for coming period on costing tool freights. Data update process starts, when administrator of costing tool will pull data from local reporting tool and send it for Outokumpu Stainless Oy logistics. Data set sent to logistics contains freight cost per transport mode and country (table 13). Costing tool administrator will compare new freights for earlier freight data set and if he/she finds something curious, he/she will send data for logistics together with finding(s) arguments. Otherwise if freight data looks fine, costing tool administrator send data without any further comments.

Logistics will evaluate the received data and if they agree the data they reply and confirm data via e-mail. If logistics have a view of coming cost changes for coming period (per transport mode, per country) on freights, they will correct the data and reply it back for costing tool administrator within applied comments. This development will now cover the freight data accuracy on costing tool and will take into account coming changes on freights, which are evaluated and confirmed by best possible experts on company.

Table 13: Freight costs for costing tool

Country	Avergage	CONTAINER	SHIP	TRAIN	TRUCK
AT	-	-	-	-	xx
BE	xx	xx	-	-	xx
BG	-	-	-	-	xx
BR	xx	xx	-	-	-
CA	xx	xx	-	-	-
CH	-	-	-	-	xx
CL	xx	xx	-	-	-
CN	xx	xx	xx	-	-
CO	xx	xx	-	-	-
CZ	xx	xx	xx	-	xx
DE	xx	xx	xx	xx	xx
DK	-	-	-	-	xx
DZ	xx	xx	-	-	-
EE	-	-	-	-	xx
EG	xx	xx	-	-	-
ES	-	-	-	-	xx
FI	-	-	-	-	xx

7 OTHER ACTIVITIES

Testing the tool started week 35/2014, when couple of test users started to test new costing tool. Costing tool tests continued, by updating new tool on parallel with first version of the tool. During the first weeks, developed costing tool new regression, variable- and fixed costs, raw material calculations, etc. were reviewed and compared against the first version. This comparison was done, since there was need to validate and compare that new tool will give accurate and obviously better results than the old one.

The tool testing was ended week 41/2014 and wider group of users was applied into tool distribution. At the same time, when distribution was extended, communication and introduction of new tool was given for end users.

Training material of the tool was built and all the existing and new items in the tool were introduced in training material. Training of the tool was given to the end users by using company remote communication system Lync.

At the beginning and obviously during the costing tool development, it has been self-clear that this type of tools exists elsewhere in company than just in Tornio. One of the similar types of costing tool used in Nirosta, was introduced for me during this development. I also got the information, that in Outokumpu all the business units have their own revision of pricing tool used for pricing.

This information raises an obvious question whether the company should start to harmonize these types of tools and build one common for whole group. Since this development was limited to review only Tornio tool, this thesis do not review any other business line costing tools. However there already is a large project in Outokumpu, which would then take even harmonization work of different type costing tools into account.

Another development request for costing tool point of view is current tool distribution restrictions. Since agreement was to build also the new tool on excel basis, it generates possible illegal use of the tool. In order to avoid any illegal use of this tool, there is a development request to build access restriction for it. By applying user access for the tool, system owner and administrator can guarantee that only permitted users are able to use the tool.

8 SUMMARY

Development of costing tool reviewed tool end user selection criteria, applied optional delivery months and changed delivery default type into average freight costs of deliveries in selected country. Development extended costing tool result table profitability view from contribution down to operating profit. Development applied also validity of the tool, where end user could view for how long used tool is valid, or if tool is outdated.

In background, this development applied new regression calculation into conversion cost model. New regression contains reviewed variable costs, new fixed cost regression and sales and marketing, general and administration and other costs. These regression calculation updates were not only done for cold rolled products, but also for semi material for black hot bands. Raw material cost future values on raw material calculation were applied. Raw material future values can give estimation of raw material costs for next 62 months.

On development all the data input processes were reviewed and updated. Imported data will be compared against earlier data and by using agreed business logic for data evaluation, all the smallest possible errors would be found. By using developed data input review, we lower the risk to use odd values on costing tool. Implemented comparison between latest update and earlier used data gives visibility of data set changes and support update process to guarantee the good data validity for costing tool.

During this development, all the costing tool elements were evaluated documented and their calculation and update process, source of values and validation were re-established where needed. Costing tool development included also comparison and sensitivity analysis between earlier used data set vs. updated data set. Development of costing tool will increase trustworthiness of used data sets and give reliable, accurate and timely correct results for end user to agree stainless steel prices with customer.

9 CONTEMPLATION

To review and develop new costing tool for Outokumpu Stainless Oy was absolutely an interesting and totally new area for me. As agreed in my earlier personal development dialog, "think outside of box", this work was reality of it. Obviously main reason to start to develop this tool was my intention to build something useful for company. I thought that even if it was demanding and hard to satisfy all the people around this topic, it was worth of it.

At least in Finland we have the saying; a rolling stone gathers no moss, where I certainly do not refer for one of the best rock n roll group in music history. Stepping out of your own comfort zone gives new ideas about how you can improve your current work. Secondly, it would be ideal to view your own work and company's other functions with "new" eyes.

Developing new costing tool for Outokumpu Stainless gave me real opportunity to learn how company pricing works in practice and by writing those learnings into my school thesis, I really hit two flies at once. Secondly, those students, who claim that they would never need any mathematical learning in real life, please think twice. During my thesis I learn how the multiple regression works, how regression data outliers need to be tackled and how you need to take into account different cost element impact for end results, all in mathematic model. If your intention is to build, develop, be involved in any sales or financial management matters, learn math!

Last I can state that building this new costing tool to company, even if it has been very busy and stressful time, it has been also absolutely great and satisfying time to complete something new for own company.

LIST OF REFERENCES

Asish K. Bhattacharyya, Principles and Practice of Cost Accounting, 2004, pages 288 – 299.

Davenport, T. & Harris, J. 2007. Competing on Analytics. Harvard Business School Publishing.

Euro Inox, The European Stainless Steel Development Association, euro-inox.org, retrieval date 17th of Sep 2014.

European Central Bank, www.ecb.europa.eu, retrieval date 3rd of April 2014.

London Metal Exchange, LME. www.lme.com, retrieval date 22nd of June 2014.

Metal Bulletin, MB. www.metalbulleting.com, retrieval date 18th of June 2014.

Michael V. Marn, Eric V. Roegner, and Craig C. Zawada. McKinsey&Company, The power of pricing. February 2003 http://www.mckinsey.com/insights/marketing_sales/the_power_of_pricing, retrieval date 7th of October 2014.

Montgomery, D., Peck, E. & Vining, G, 2012. An Introduction to Linear Regression Analysis, pages 12 – 21 and 67 – 74.

Outokumpu Intranet, 2014. Retrieval date 29th of October 2014.

Thomas J. Archdeacon, Correlation and Regression Analysis: A Historian's Guide, 1994, Pages 98 -99.

Untinen, T., Knuuti, J. & Pitko Pertti, 2014 Outokumpu Stainless Oy, meeting at 23rd of June 2014.