

# Value-Analytical Revision and Cost Reduction on a Stainless Steel Pickling Line - Consideration of Special Customer Requirements in Plant Construction



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## **1. Abstract**

The Andritz AG, based in Graz, Austria, is an international technology group in mechanical and plant engineering. Important products here are the so-called pickling lines, which ensure optimum descaling of hot- and cold-rolled strip (carbon steel, stainless steel, non-ferrous metals) through processes developed in-house. The management of the Metals Business Area has decided to carry out several value analysis projects on products that are strategically important for Andritz, including the so-called stainless steel pickling line.

The project objectives were as follows:

- Reduction of manufacturing costs by at least 15%.
- Plants optimized for the customer application incl. individual components
- Customer and market-oriented design of the system
- Optimized coordination/communication of all areas involved in the product
- Transferability of results to Other Andritz Product Areas

Special requirements in the project were

- The extreme complexity of the plant
- Low quantities of systems, but sometimes high repetition rates within the components
- International business with various customers and requirements

The project procedure was based on the value analysis methodology:

- Work in a cross-functional team with temporary support from specialists
- Collecting and analyzing customer-relevant requirements
- Compilation and evaluation of competitive information
- Survey of specialists (chemistry, assembly, commissioning, automation)
- Analysis of reference projects
- Function analysis and function cost analysis, e.g. to prioritize idea generation (cost-driving functions)
- Idea search in the functions
- Evaluating ideas and transforming them into measures
- Combination of measures into new concepts accepted by the customer
- Implementation of the measures, as far as already possible during the project

Nearly 300 individual measures had been developed by the time the project was completed. As there are some redundancies in the measures, several concepts for possible implementations were developed and proposed for implementation. The implementation effort for the measures or packages was worked out and compared with the savings in terms of a profitability analysis. This results in capital return times of less than 1 project. The project was assessed very positively by the management, not only with regard to the monetary savings, but also in particular with regard to the improvements in internal communication and know-how transfer.

## **2. Andritz Metals**

The Andritz AG is an Austrian Technology Group in the business of machinery and plant engineering with its headquarter in Graz, Austria. It is named after the borough „Andritz“ in Graz. The international technology group is listed at the Vienna Stock Exchange and employs currently around 30.000 employees at 220 production, service and sales facilities all over the world. The Andritz AG is World Market leader in all of its five business areas: Hydro, Pulp&Paper, Metals, Separation and Feed&Biofuel. In 2017, Andritz created a turnover of around 5.8 Billion EUR at an EBIT of 6.8%. The business area METALS delivers complete lines for production and processing of cold rolled stainless steel strips, consisting of plants for rolling, heat treatment, surface treatment, strip coating and strip finishing, for punching and thermoforming and for regeneration of pickling acids. Additionally, Andritz designs plants for processing carbon steel and non-ferrous-metal strips as well as turn-key furnace systems for Steel, Copper and Aluminum processing.

## **3. Task and goal of the project**

Due to the highly competitive and stagnating market, Andritz's management has decided to revise the APL (Annealing Pickling Line) and ARP (Acid Regeneration Plant = HCL-Regeneration) product areas in order to reduce costs in such a way that on the one hand higher price elasticities can be achieved for winning further orders, and on the other hand significant improvements in the Business Area's results can be achieved.

Andritz's customers are steel producers all over the world. Accordingly, the development of customer-specific plants has to take into account a wide variety of customer requirements, different supplies, and, in some cases, local design capacities.

In the product area of annealing and pickling lines (APL), a concentrated project has been carried out to analyze the value of the pickling line components in order to work out a considerable cost reduction.

The concrete scope of consideration went from the belt infeed into the "Pre Rinse" via the "Pre-Pickling-Section" via the "Scrub Brush Machine (SCBM)" to the "Mixed Acid Pickling Section (1+2)". The end of the line section is followed by an SCBM and a final rinse. Other projects included edge drying, belt drying, "DeNOx" catalytic flue gas cleaning and a wide variety of tanks.

The costs for a typical plant include not only the actual components, some of which are manufactured in-house, some of which are manufactured externally and, if necessary, even provided by the customer, but also assembly/commissioning and engineering.

The project objectives were the definition and conception of the cost-optimized pickling section of an "APL", in concrete terms:

- Reduction of the manufacturing costs for the pickling line by >15%.
- The revision of the pickling line was designed to optimize the function and value of the pickling line in order to achieve further orders and significantly improve Andritz's earnings situation.
- The new plant concept should be available in January 2013, and it should already be possible to implement possible "quick wins" in ongoing projects.
- Individual plant components should be functionally optimized in order to provide further sales arguments to the sales department.
- A further goal was the standardization and harmonization of plant designs within Andritz.

#### 4. Project Procedure

The procedure in the project continues to be based on the work steps of value analysis, the value analysis work plan according to VDI 2800/EN 12 973, using various methods in the individual steps.

Steps	1. Prepare project	2. Analyze object situation	3. Describe future state	4. Develop ideas for solution	5. Determine solution	6. Implement solution
	<ul style="list-style-type: none"> <li>• Appoint moderator / project leader</li> <li>• Take on assignment, define targets and guidelines</li> <li>• Build team</li> <li>• Define boundaries</li> <li>• Define project organization</li> <li>• Plan project</li> </ul>	<ul style="list-style-type: none"> <li>• Gather object information</li> <li>• Gather cost information</li> <li>• Determine functions</li> <li>• Determine framework for solutions</li> <li>• Determine cost per function</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate information</li> <li>• Determine target functions</li> <li>• Determine framework for solutions</li> <li>• Cost of target functions</li> <li>• Verify assignment and determine potential</li> <li>• Decide on next steps</li> </ul>	<ul style="list-style-type: none"> <li>• Collect ideas</li> <li>• Develop new ideas</li> </ul>	<ul style="list-style-type: none"> <li>• Define assessment criteria</li> <li>• Evaluate solutions</li> <li>• Work out solution concepts from the ideas gathered</li> <li>• Evaluate alternative solutions</li> <li>• Work out details for solution</li> <li>• Assess solutions</li> <li>• Prepare decision finding</li> <li>• Decide</li> </ul>	<ul style="list-style-type: none"> <li>• Plan implementation in detail</li> <li>• Start implementation</li> <li>• Control realization</li> <li>• Close project</li> </ul>
Steering committee	●	D	I	I	I	D
Team		A	A	A	A	S
Specialist department	Sp	Sp	Sp	Sp		D

D = Decision      A = Accomplishment      I = Information      Sp = Support      S = Steering

Figure 1: VA/VE work plan based on VDI 2800, for simplified here in six steps

The whole work from the analysis to the realization support was divided into 3 phases, in order to have orientation and overview on the way:

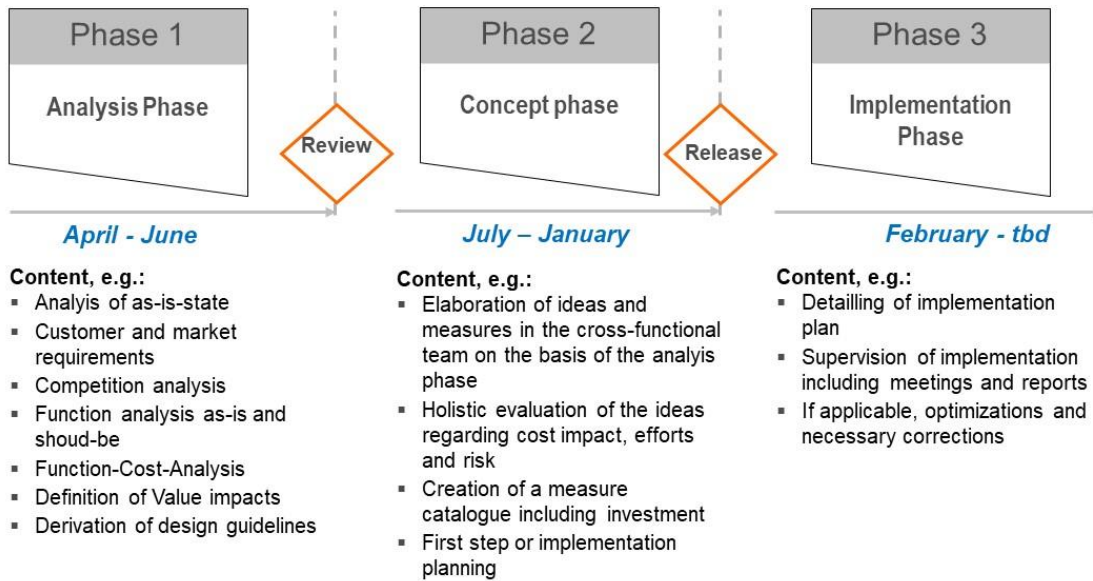


Figure 2: The three project phases

### Project Preparation

In a first kick-off, the project objectives were validated together, and the individual work steps were defined jointly with the team on the basis of the work plan. The tasks and objectives were discussed explicitly. The team members had the chance to question the plan. Mr. Göschl was appointed Project Manager, who as Product Manager for the pickling lines at Andritz Metals is the contact person for all Mechanical Engineering activities.

Another relevant aspect of the method is the work in interdisciplinary teams, since only interdisciplinarity can achieve an optimal result.

**Team composition:**

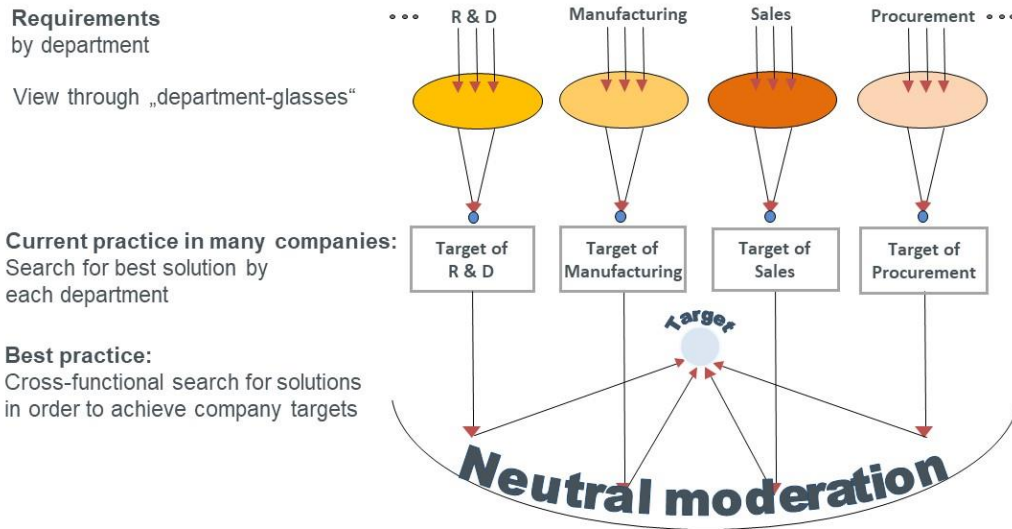


Figure 3: Reasons for a cross-functional team and neutral moderation

In special cases, the team was extended by specialists to add further expertise to the core team as needed. The team meetings took place in an approx. 10-day rhythm, whereby the interests of the team members were taken into account so that the tasks of the daily business could also be completed parallel to the project work.

<b>task setter:</b>	head of engineering	
<b>steering circle:</b>	head of engineering, deputy, project leader, external project leader	
<b>core team:</b>	<b>extended team</b>	
int. project leader/engineering	research & development	
engineering	erection & commissioning	
sales	engineering	
electric & automation	engineering DENOX systems (specialist)	
purchasing	engineering pickling tanks (specialist)	
erection & commissioning	electric & automation	

Figure 4: Composition of the interdisciplinary project team

Apart from a few exceptions, the core team members were permanently present at the team meetings, while the temporary team members were invited to the specially themed meetings. However, all team members were present for the kick-off and theoretical introduction to the methodology of value analysis.

## 5. Analytic Phase

In the analysis phase at the beginning of the project the key data of the project work were worked out. In addition to the internal parameters, such as the overall cost situation of the plant, in this case especially a typical reference order and a possible quantity structure of the individual components, the data of the sales market were then analyzed using the QFD methodology, among other things.

### Competition Analysis:

In the first step of the competitive analysis, the decisive criteria for the purchase of the product were developed, i.e. which criteria the customer applies to the product and consciously or unconsciously measures the benefit of the product by fulfilling these criteria. In the concrete case the following criteria resulted, whereby also explicitly criteria of the "extended product" were added. This refers to criteria that cannot be identified directly from the product, but very well from the processes of the supplying company. The presentation of references is extremely important, especially in plant construction. A plant constructor without references will have a hard time convincing a potential customer that the supplier has mastered the technology. A large number of references makes it very easy for the supplier to prove that he is the "right" partner for the customer.

Kriterien	Wettbewerber								
		Gewichtung	ANDRITZ	A	B	C	Best practice	Handlungs-Bedarfe	Differenz-lerungs-chancen
Reputation am Markt, Image	1	10	20	20	30	10	30	10	10
Betriebskosten	2	5	10	10	10	10	10	0	5
Gute Beziehung zum Kunden, Vernetzung	3	8	16	24	24	24	24	8	8
gute Zugänglichkeit	4	8	24	24	16	8	24	0	0
Stabilität des Lieferanten	5	5	10	10	10	10	10	0	5
Raumbedarf	6	6	12	12	6	12	12	0	6
Energieeffizienz	7	6	6	6	6	6	6	0	12
Zeit für Aufbau und IBN	8	2	4	6	6	6	6	2	2
Skalierbarkeit	9	1	1	1	1	1	1	0	2
Umweltverträglichkeit/Nachhaltigkeit	10	6	12	12	12	6	12	0	6
Zuverlässigkeit, Uptime	11	10	30	30	30	10	30	0	0
Kurze Behandlungszeit	12	4	8	8	8	8	8	0	4
Einfachster Produktwechsel	13	6	12	12	12	12	12	0	6
Wartungsfreundlichkeit	14	7	21	14	14	7	21	0	0
Zeitgemäßes Aussehen (Anmutung, Optik)	15	6	12	6	6	0	12	0	6
Response-Time, Beratung	16	8	16	16	16	8	16	0	8
After-Sales	17	1	1	2	1	0	2	1	2
<b>Kundennutzen</b>			<b>215</b>	<b>213</b>	<b>208</b>	<b>138</b>			

Figure 5: Competitive comparison (neutralized)

In the next step, the competition comparison was then carried out on the basis of the weighted purchase criteria. Each competitor's product and, of course, its own product are measured and evaluated against each criterion. Each evaluation, multiplied by the weight, then leads to a customer benefit value, which is later added up for each market participant and leads to a total customer benefit. In addition, further important information such as the need for action (if a competitive product fulfils a criterion better than its own product) or opportunities for differentiation (if no competitor fulfils the criterion to the fullest satisfaction of the customer) arise, which must then flow into further project work.

The summarized customer benefit plotted against the actual market price taking into account the (as well as possible determined but frequently estimated) market share then delivers the so-called customer benefit price portfolio, from which the future product strategy can then be derived. Especially in this project, important design guidelines for idea generation, but also the later design of the products to be reworked could be derived.

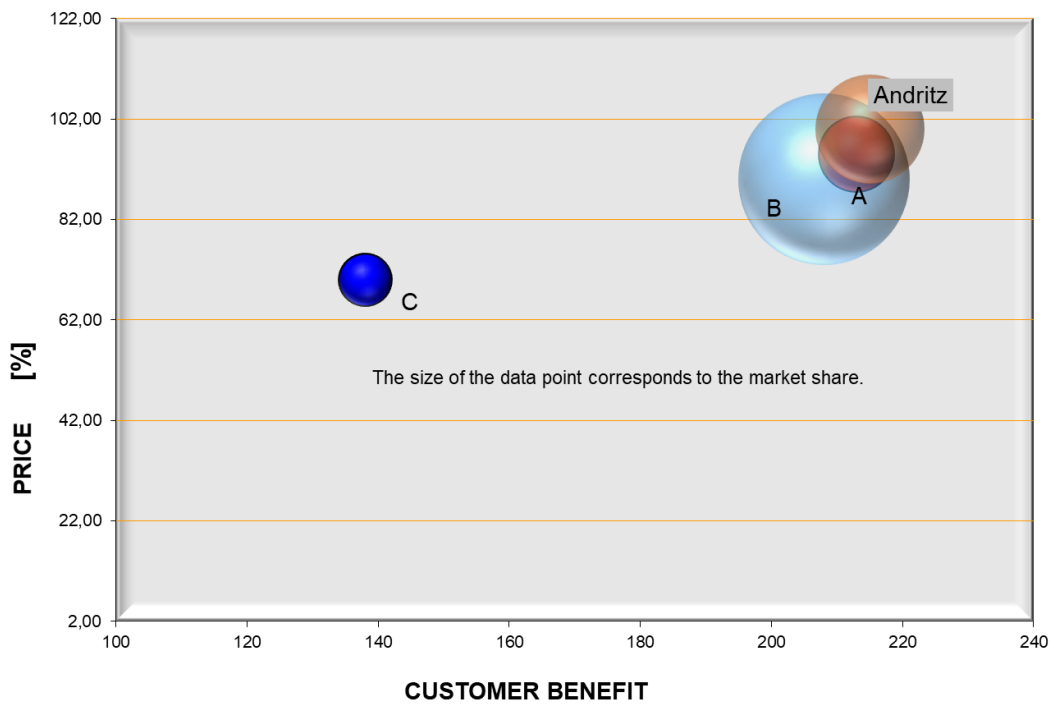


Figure 6: Customer benefit price portfolio (neutralized)



## Function Analysis

The central element of value analysis is function analysis. For the project scope to be examined here, the "Top Level" function analysis was carried out first, i.e. for the entire plant. This top-level function analysis is primarily used to consider the function costs and later compare them with the target function costs in order to be able to structure the brainstorming according to the values in the project scope. On the basis of the overall function "Improve belt surface", the function tree was then first created by collecting the functions and then structuring them.

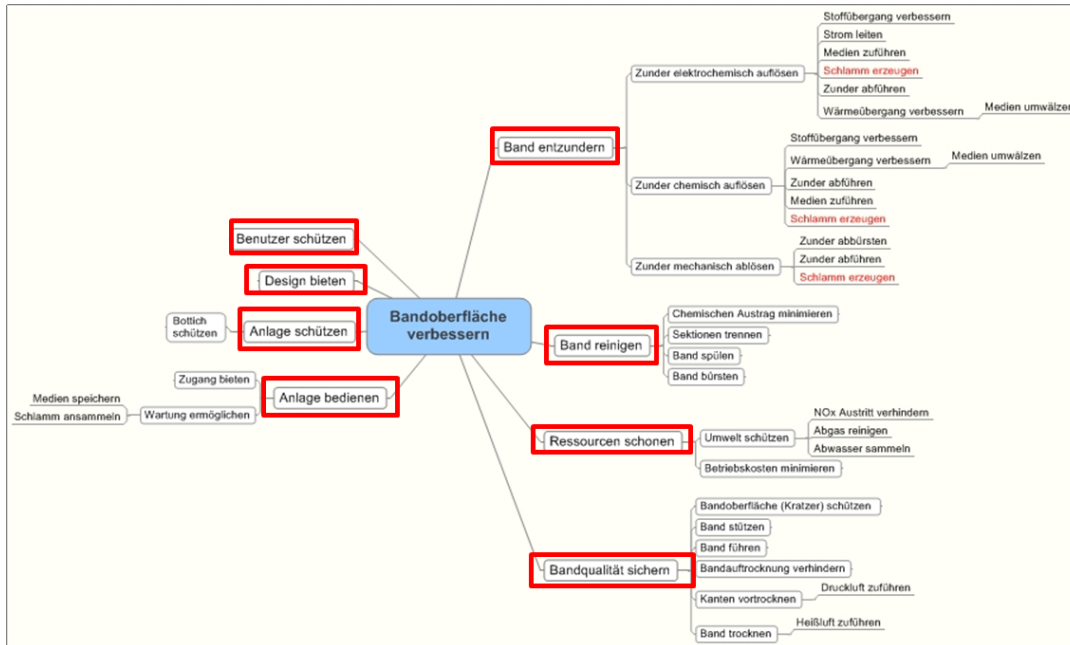


Figure 7: Current product function tree (excerpt)

In the later course of the investigation, in each case in the brainstorming for the sub-functions, the decisive assemblies were also subjected to a function analysis in order to have maximum knowledge available for an effective brainstorming.

Using the functions outlined in red in the function tree, the costs were then assigned to the functions in order to be able to display the function costs of the actual state. This data was later used to compare the function costs with the target state.

The target function analysis was also carried out in the team afterwards. As a result, the main functions of the actual function analysis were confirmed here. Unwanted functions were removed. By re-formulating individual functions, the optimal degree of freedom for idea generation was determined.

## Target Function Costs

The main finding from the target function analysis was then the target function cost analysis. Here again, the criteria from the competitive comparison that are decisive for the purchase are used and their correlation to the functions is determined. A high correlation between the target function and the purchasing criterion (positive influence in the sense of the customer) reflects the value that a customer would place in a function. The extensive correlation matrix can then be used to redistribute costs from the customer's point of view. However, the target costs have to be taken into account: According to the project specifications, 15% less costs have to be distributed in the target state than in the actual state.

	Anforderungen										
		Reputation am Markt, Image	Betriebskosten	Gute Beziehung zum Kunden, Vernetzung	gute Zugänglichkeit	Stabilität des Lieferanten	Raumbedarf	Energieeffizienz	Zeit für Aufbau und IBN (Erreichen der Ziele)	Skalierbarkeit	Umweltverträglichkeit/Nachhaltigkeit
	Gewichtung	10	5	2	8	5	6	6	2	1	6
Funktionen											
Band entzundern		9	6	0	3	0	9	9	6	6	6
Band reinigen		6	3	0	3	0	6	6	3	3	6
Ressourcen schonen		6	9	0	3	0	3	9	3	3	9
Bandqualität sichern		9	6	0	3	0	3	6	3	3	3

Figure 8: Correlation matrix for the target function costs

In the evaluation of the function costs for the actual and target state, the following bar chart was then produced, from which further findings for the project work could be derived:

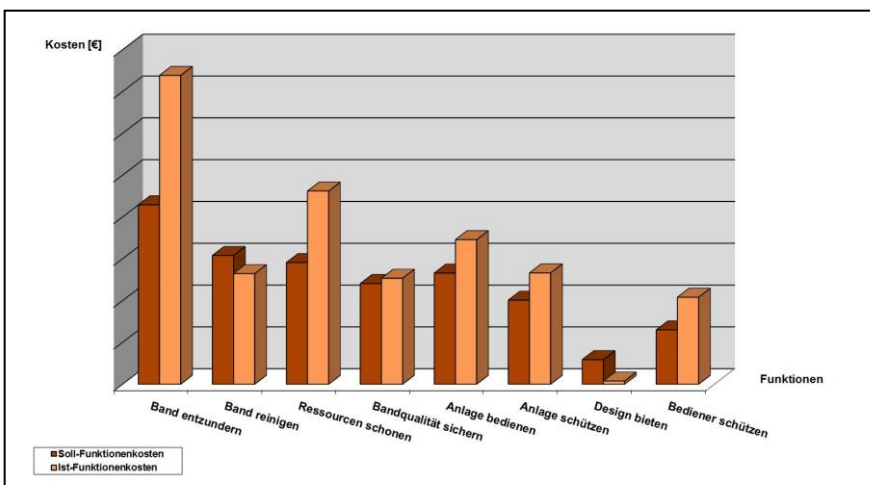


Figure 9: Function cost diagram (TARGET/CURRENT)

The graph shows that there were already some cost-driving functions in the actual state that needed to be examined regardless of the distribution in the target state, as they caused a considerable proportion of the costs. In addition, according to the target function cost analysis, the customer was not prepared to put costs into the product to the same extent as today. But there are also some functions where the actual and target costs of the functions are very similar. However, since in absolute terms these were also cost-driving functions, they were nevertheless treated with slightly lower priority in the brainstorming process.

## 6. Creative Phase

### Search for Ideas

Using various creativity techniques (brainstorming, mind mapping, etc.), ideas were collected on the basis of all the findings so far, which could contribute to cost savings or product improvement. Initially, ideas for the most cost-driving functions were collected. After the flow of ideas had ebbed away, the main assemblies were examined with regard to the cost structure of their subassemblies down to the individual parts in order to find as many ideas as possible. The background of this methodical approach is to find conceptual ideas, that is, ideas that lead to a more revolutionary than evolutionary solution. Experience has shown that although these conceptual ideas are associated with more implementation effort, they usually promise much more drastic cost reductions and/or increases in value for the customer. When considering components in detail, "only" evolutionary solutions are often found, which are also interesting, but can rarely be a so-called "game changer".

Funktion		Nr.	Idee	Potenzial	Fiskosten	Anmerkungen	Aufgaben	Verantwortlich	Termin	Status
Bandtrockner	4	Hautschonmat völlig weglassen	D			Da Kantentabbläsung immer vorhanden, kann Bandtrockner weglassen; Auch aus Verfahrersicht OK.	Maßnahme am Auftrag JIN-CAPL2 und JIN-HAPL testen; Hr. Freimann/Hr. Ochenbauer kümmern sich	Hr. Göschl		
Gesamt-Anlage	5	Transportoptimale Ausgestaltung (Containermaß einhalten)	K			1. Ansatz: 10% Einsparung bei Plankosten von 220.000 € bei der Referenzanlage				
Pre-Pickling	6	Keine Ausmauerung bei Stahl-Gummieten Pre-Pickling Bottich	D			Heutige Gummiqualität verhindert Diffusion von Wasserstoff; tatsächlich schützen auch die Elektroden die Gummierung	Kosten der Ausmauerung (Lohnkosten) ermitteln; müssen dem Potenzial noch zugeschlagen werden	Hr. Göschl	29.01.2013	
Pre-Pickling	12	Deckelheber: 1 Zylinder pro Deckel	D			Schätzwert: 5000 €. Zudem Funktionsverbesserung (2 kl. Zylinder kosten 2000 €, 1 gr. 1500 €) 5000/Deckel + 6 Deckel + Mechanik und Montage; Prinzipiell möglich; Querträger im Untergestell berücksichtigen				
Absaugung	13a	Alternativkonzept Absaugung wie bei Auftrag ALC ATL	D			Schätzwert: 2500 € Material und Fertigung. Zusätzlich				
Absaugung	13b	Absaugleistung verringern	K			Wettbewerb hat wesentlich kleinere Querschnitte		Hr. Maksimovic		
Anoden	16	Kostengünstigere Gestaltung des Verschleißschutzes (wie bei Kunde LISCO)	D			evtl. technische Vorteile, jedoch keine Kostenreduzierungs-effekte				
Kathode	21a	Edelstahl 4404 anstatt Stahl verblei verwenden	D			14301: Ohne Schutzspannung nicht. Bei Stromausfall besteht Korrosionsgefahr.	Kostenvergleich auf Basis der existenten Aufträge; Klären: Geht auch 14301?	Hr. Göschl		

Figure 10: Excerpt from list of ideas with alienated numbers

In this project, about 300 concrete measures for cost reduction or value improvement were developed across all functions and main assemblies. The quality of the ideas in the interdisciplinary team was extremely high despite the high attention paid by the moderator to separating the creative phase from the evaluating phase. This was reflected in a relatively small number of measures that could not be implemented (either no cost reduction or from a technical point of view not feasible).

## 7. Evaluation Phase

After the creative phase, all measures found in the team were first subjected to a rough evaluation. According to relatively general evaluation criteria, a distinction could now be made between:

Conceptual ideas, i.e. those ideas that strongly question the previous solution, possibly entail considerable effort for the change, but often involve a correspondingly high savings potential or partly also an improvement in function in the sense of increasing value for the customer.

Detail ideas, i.e. those ideas that only affect the design of the components in detail, whose concept usually does not influence, can usually be implemented relatively quickly and therefore entail little implementation effort. Although there are some detailed ideas with significant cost reduction potential, the "potential yield" of these ideas and measures is usually much lower than with conceptual ideas.

But even here, ideas and measures must be eliminated if, for example, the idea is not technically feasible, i.e. there is either no technical implementation or the function of the object would be endangered.

In addition, there are ideas that are generally target-oriented and cannot be implemented within this project for certain reasons (e.g. special customer requirements, but also internal reasons). However, at a later point in time or in other products there may well be a probability of implementation. For this reason, such measures are evaluated as "outside the task". However, these ideas are in fact no longer dealt with in the further course of the project. In addition, idea generation also allows for redundant ideas, which, however, must be filtered out in the rough evaluation. The statistics in the project considered here provided the following data:

### Ideas:

- 298 measures for 150 evaluating assemblies were developed
- 148 of which not realisable (50%)
- 103 are valued as "detail"
- 38 are rated as "concept"

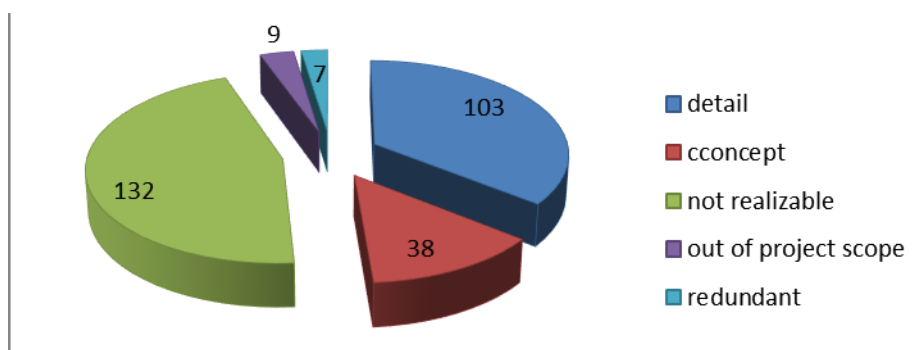


Figure 11: Split of ideas according to the rough evaluation

The chart above shows a typical distribution of ideas after the rough evaluation for value analysis projects. Approximately 50% of all ideas have to be rejected, which means that the "surviving" ideas are responsible for achieving the goal. A further indication of how important the quantity of ideas is in the creative phases. Well-trained teams tend to leave the "wild ideas" in their personal idea memory and not to feed them to the team. Here again the enormous importance of the moderator shows up, who must try to overcome the last idea brakes of the team members.

### Intermediary evaluation

All measures with a rough "detail" or "concept" evaluation have now been subjected to a much more detailed evaluation of funds. Initially, the study focused on two criteria:

- Cost reduction (in € related to the reference order)
- Implementation effort (working hours in design and development multiplied by the applicable hourly rate)

It should be noted here that the implementation effort in plant construction refers less to the procurement of tools, fixtures or even machines, but mainly to the effort in design and development. This is because the comparatively low repetition rates compared to series production mean that the expenditure is almost exclusively on engineering.

## **8. Concept Phase**

After the evaluation of the surviving measures had been completed, it was now necessary to harmonise the correct measures with each other and to transfer them into coherent overall concepts. It quickly becomes apparent that some measures cannot be combined with each other; a pure "adding up" of the potentials is not permissible and leads to exaggerated expectations of the project result.

However, concept development can also be carried out using project-specific findings. Criteria can also be developed for concept development, against which the ideas found and evaluated can be measured.

In the concrete case the criteria were developed here:

- Minimum effort required for implementation
- Highest possible customer acceptance (customer may not even notice the change)
- Absolute cost savings (monetary effect).

These criteria are essential for the correct concept development in this project, because:

In times of staff reductions, budget cuts and ever faster time-to-market, capacity is a very limited commodity, especially in engineering. This must be handled as carefully as possible.

In plant construction you often have to deal with very conservative customers. Experiments are not desired; the reliability of the plant and the lowest possible production downtime are decisive in view of the enormous costs involved in operating such a plant. It must also be taken into account that the part under consideration here can in turn be part of a complete plant. Malfunctions here lead to malfunctions in the entire plant with

incalculable financial consequences. Even if technically good and robust solutions have been developed with the ideas, this does not mean that the customer trusts them - especially not if the previous conservative technology may be a good example in the neighbouring hall. So, we have to be cautious here. Ideally, the customer will not notice the change in technology at all.

Nevertheless, such technologies can also be brought forward through the savings effect. In individual cases, a customer is prepared to move away from a proven technical solution if the savings effect becomes all too clear.

In the project discussed here, a total of four concepts were developed, which can be described as follows.

Nr.	Konzept	Merkmale
1	„Quick-Win“	All measures can be implemented from a technical point of view; implementation effort low; customer notices, however, some changes, possible acceptance problem
2	„Realistic“	All measures can be implemented from a technical point of view; implementation effort medium to high However, the customer notices some changes, possibly acceptance problems.
3	„Maximum Savings“	All measures can be implemented from a technical point of view; significant implementation effort; customer acceptance of some measures not given; some measures violate the ANDRITZ Global Product Quality Policy.
4	„100% customer acceptance“	All measures can be implemented from a technical point of view, implementation effort medium; customer acceptance for all measures given.

Figure 12: Four different implementation scenarios with the respective criteria

It has to be said that the so-called "quick win concept" contains measures that are not necessarily accepted by the customer without comment. However, the implementation effort for the manufacturer of the system is comparatively low.

The "100% customer acceptance" concept only includes measures that even an existing customer, for example one who already has a comparable system in house, would easily accept. The implementation effort is significantly higher compared to the "Quick-Win" concept.

The "realistic" concept combines all measures that can be implemented from a technical point of view. In some cases, there are considerable implementation costs. In addition, measures are included that an existing customer would not necessarily accept, since he knows the old, proven solutions. However, a new customer would accept such measures. New customers who are not yet used to certain "features" and equipment features of existing ANDRITZ plants can also be served with plants based on this concept. The higher cost savings allow either higher coverage or more aggressive pricing.

The "maximum concept" combines measures without regard to customer acceptance on the one hand and implementation costs on the other. This concept shows at which costs a plant would be representable. However, since this would involve considerable implementation effort and the sales success is more than uncertain, this concept should be regarded as hypothetical. But the team wanted to show what is generally possible.

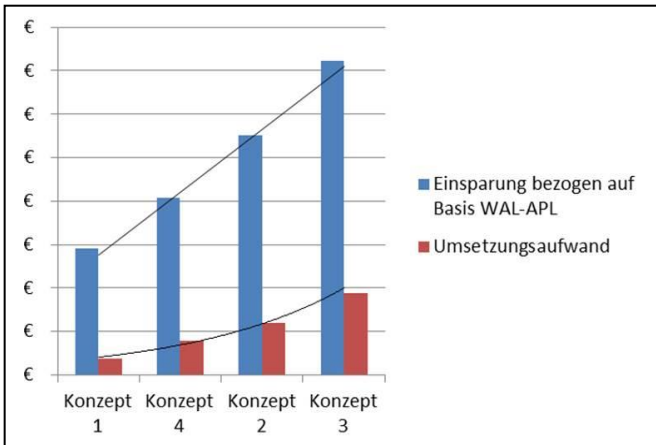


Figure 13: Monetary valuation (neutralizes) of concepts vs. implementation effort

The graph shows the possible savings per plant and the associated implementation effort in direct monetary relation to each other across the various concepts. Here it can be seen that the absolutely high expenditure for implementation is in such a favourable relation to the expected cost savings that even the "maximum concept" would pay off with the next plant to be designed. Even if the potential and expense calculation had been too optimistic, the benefit of the cost reduction measures is still so drastic that a very fast return on investment is possible.

Ultimately, the project steering committee was recommended to implement two concepts constructively, namely:

Concept 4 100% customer acceptance and concept 2 "realistic".

In both cases, cost savings are achieved that significantly exceed the original task. Even with the conservative concept "100% customer acceptance", almost 20% cost savings are achieved. The value of the savings with the "realistic" concept is significantly higher.

Particular mention should also be made of a number of measures in the "Realistic" concept which, relative to the industry standard, can certainly be described as innovative. Ultimately, it is such measures that can secure the technological leader's lead in the medium to long term.

In the short and medium term, existing customers are to be served with Concept 4, while new customers can be offered Concept 2 with a much more aggressive pricing policy. The decision of the steering committee for the proposed procedure was then only a formality.

## 9. Implementation planning

The planning of the implementation was also part of the project work, whereby the team members were also involved, who were involved from the analysis phase to the concept phase.

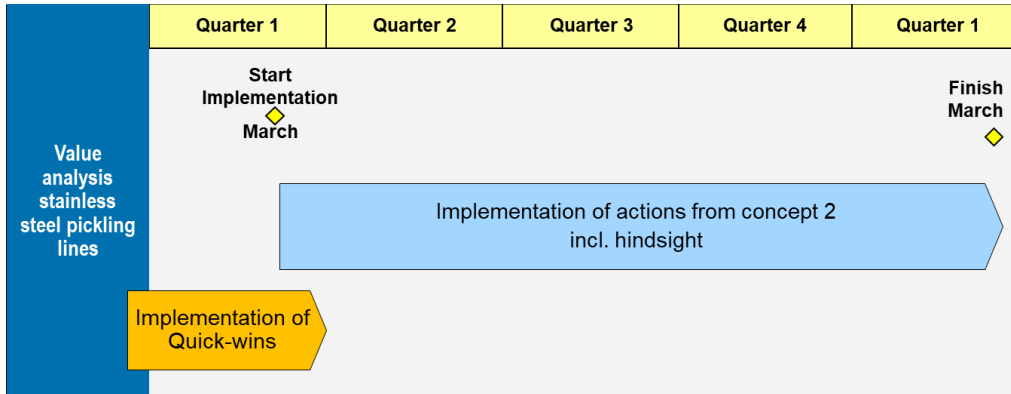


Figure 14: Implementation Schedule

This approach leads to considerable advantages in project realization through project control in the established team:

- The cost savings are the responsibility of the same people who made the forecast.
- Possible difficulties are managed by the same people who initiated the corresponding measures.
- In the current project team all affected areas are involved => max. acceptance of the jointly developed measures in all areas.

The current project team is familiar with the content and background of the developed measures => no training period and no further questioning of the measures.

Baugruppe	Einsparung in % der HK
1 Waschbürstmaschine	5%
2 Behälter	4%
3 Anoden/Kathoden	3%
4 Bottiche	2%
5 Elektrik/Instrumentierung	2%
6 Dicht- und Abquetschwalzen	1%
7 Absaugung	1%
8 DeNOx	1%
9 Gesamt-Anlage	1%
10 Pre Rinse	1%
11 Kantenabbläsung	0%
12 Gaswäscher	0%

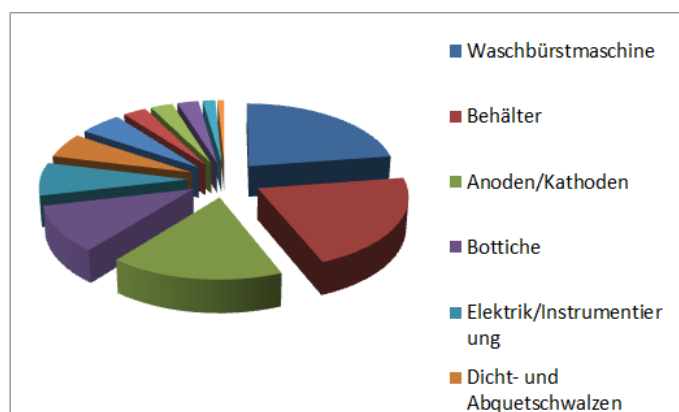


Figure 15: TOP 12 of the assemblies to be reworked sorted by savings



### Estimation of the realization effort

Since Concept 2 "Realistic Concept" essentially also contains all measures from Concept 4 "100% Customer Acceptance", the determination of the implementation effort was carried out on Concept 2. The efforts of the individual measures contained in the concept were combined on the assemblies in order to achieve as many synergy effects as possible. However, these synergy effects could not yet be quantified in the cost estimation status.

Implementation Effort for Concept 2				
			Effort in €	Effort in hr.
in total	96 single measures		240.870 €	3256
additionally		20%	48.174 €	651
	effort for planning and coordination (based on experience K&P)			
double check	1,5 team meetings per month with about 8 month with 6 team members			576
Sum	internal implementation effort		289.044 €	3906

Figure 16: Estimation of the implementation expenditure

The following conversion schedule was set up on the basis of available capacity and, if necessary, "suitable" orders for the measures. It should be noted that many "quick-win" measures have already been implemented in current orders, even during the actual project period, provided they are accepted by customers.

### 10.Outlook on the realization phase

In the subsequent implementation phase, the essential work steps and contents are as follows:

- Creation of work packages that make sense in terms of content and summary of measures for optimal resource utilization
- Scheduling based on work packages and assigned persons
- Constant review of the implementation of possible "quick wins" accompanying the project work in ongoing projects
- Regular team meetings to ensure that the implementation efforts and deadlines are adhered to

## 11. Summary

In the project presented here, a new concept with considerable cost reduction was presented at a value analysis object of highest complexity. The complexity of the object is characterized by several factors:

- Scope and number of assemblies to be inspected
- Few to low repetition rate of different components per job (however, repetition rate across jobs is quite present)
- Little opportunity for experiments, reworking of orders endangers the profitability of the projects ("the first shot has to be made")

The decisive factor for the success of the project was precisely the system elements of the value analysis:

- Interdisciplinary teamwork with a permanently working core team and specialists called in temporarily along with external neutral moderation
- A comprehensive analysis of the current situation with customer requirements, competitive view and product positioning
- Function analysis at the level of the overall system AND at the level of assemblies and components
- Prioritization of the idea generation on the basis of the function-cost consideration
- Open creativity to find a multitude of ideas
- Neutral evaluation of ideas with regard to evaluation criteria defined in the team
- Compression of ideas into conclusive, marketable concept solutions

Without the interaction of these components, as the feedback of the project participants shows, such a result could never have been achieved.