Value Impact of Welding Management Software Over the Welding Value Chain

1 Introduction

Optimizing the network of suppliers, subcontractors and their actions can create significant value impact for the industrial manufacturing customer. This is why new technologies, the principles of lean manufacturing, Six Sigma and Industry 4.0 solutions are reaching across wide supply chains to realize this potential. As in all process driven business, the improvements create a cumulative value impact and span across competing supply chains of multiple collaborating companies[1]. For a subcontractor to achieve a competitive stance on the market, it needs to be able to collaborate with the whole supply chain in a flexible, agile and transparent manner. This is why separate and geographically distributed companies are being integrated more and more by digital technologies, automated processes and data sharing[2].

Welding process as a part of a manufacturing supply chain can increase shareholder value by improving value drivers suchs as revenue growth, operating margin and asset efficiency of the end customer[3]. This white paper demonstrates the value potential that introducing a welding management software provides on all stages of the welding process from manufacturing planning to final documentation of the deliverables.

1.1 Key terminology

Value potential is the maximum value company is able to achieve from improved process or business area.

Expected value is the most probable estimation the amount of value company will achieve from the improvement under existing circumstances

Value impact is actual change in production after the improvement actions

Arc-on time ratio describes actual welding time in comparison to selected period used for welding documentation and other secondary tasks.

A Welding Procedure Specification (WPS) is the formal document describing welding procedures, providing direction to the welder or welding operators for making quality production welds as per the code requirements.

Non Destructive Testing (NDT) is a wide group of analysis techniques used in science and technology industry to evaluate the properties of a material, component or system without causing damage

[1] Travail, transparency and trust: A case study of computer-supported collaborative supply chain planning in high-tech electronics, Henk Akkermans, Paul Bogerd, Jan van Doremalen, European Journal of Operational Research 153 (2004) 445–456
[2] Agile supply chain capabilities: Determinants of competitive objectives Y.Y. Yusuf, A. Gunasekaran, E.O. Adeleye c, K. Sivayoganathan
[3] See Enterprise Value Map by Deloitte: http://public.deloitte.com/media/0268/enterprise_value_map_2_0.pdf

1.2 Sources of potential value

Welding management software activates several sources of potential value spread throughout the whole welding process. Most value is gathered by automating documentation processes and minimizing the overall costs related to repair. Cumulative value is gathered from WPS management, improved prolongation process of welding qualification certificates and improved arc-on time ratio in product refinement.

1.3 About the Examples

Throughout this white paper we are using case examples based on real life equivalents. However, the actual value potential areas are different for each manufacturer, depending on their situation, production type and location.

2 Quality control and cumulative value

Improvements related to quality control cumulate in many ways. Reducing the time one welder uses for repairs also reduces time spent on managing quality issues and turns into more productive welding time.

Estimated cost for repairing welds after the inspection is approximately 400 €/m, when a possible deviation is recognized in NDT (Non Destructive Testing) inspection inside of the workshop. Even a small improvement will cause immediate savings and decrease the possibility of a larger repairing project. A good example of improved WPS compliance control is Kavamet Oy. This small company in Northern Finland managed to reduce inspection repair rate from 3,2% to a really excellent level, 1,9%. This over 40% improvement produces approximately 2000 € savings for each welder in each coming year. The same improvement in a midsized company with 50 welders will create approximately 100k€ yearly savings.

When the cumulative impact for reduced repair rate is calculated for example for a workshop that produces high quality steel structures with 20 welders, the generated overall value is significant. The same phenomena is valid in shipyards where arc-on time ratio for productive work takes a bigger role. With a large amount of welders, even a slight improvement in repair rate and arc-on time ratio will produce significant savings.

If and when the welds contain deviations such as low penetration, it is important to recognize deviations as soon as possible. Based on Kemppi Oy welding expert experience, the use of welding management software enables companies to catch welding defects early on. The earlier the defects are caught, the cheaper it is to perform the needed repairs. The following chart describes the price of a welding defect throughout the welding process.

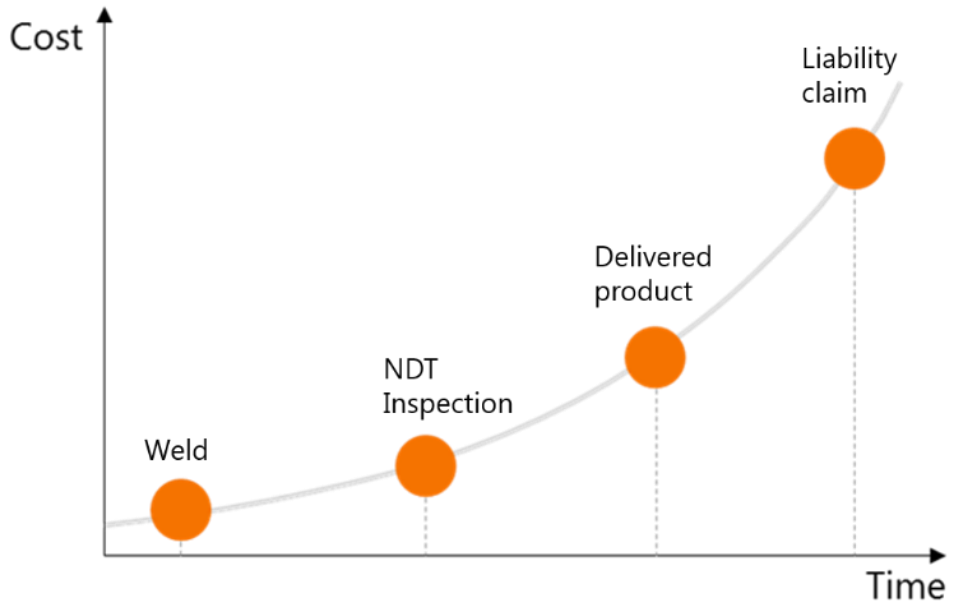

Figure 1: The later critical welding defect is recognized, the more expensive the repairing is

Deviation recognizing immediately after the welding

All-round welding management system provides 100% traceability of each weld and owns WPS and personnel qualification compliance control functions. This means that the welding management system verifies the welder qualifications and compares welder performance to the WPS in real time and reports the possible deviation immediately after the welding.

NDT Inspection

If the deviation is recognized immediately after the welding, the repairing cost is only lost time from productive work. If the deviated weld is recognized in NDT inspection the estimated cost is approximately 400 €/m. Repair cost comprises planning of the rework procedure, time to move the part to the repair location, time to move the welder from one location to another, arc gouging/grinding, heat treatment, repair welding, reinspection by third party and reporting. After this stage the weld is usually accepted, but it is still not a single incident when welders are invited to other side of the continent to repair deviated welds. All this time these welders are off from productive work.

Usually the inspection rate is approximately 5-7%. That means 1/20 inspected welds needs repairing work. The example above (Kavamet) already had very good rate of 3,2% but still they managed to decrease that by over 40%.

Delivered product

At this point the end customer will drive acceptance testing that might contain some NDT inspections to most relevant welds. Without welding management software in use, the end customer rests on documentation that is not waterproof. Comprehensive welding management system creates a thorough documentation of all the welds, assuring the end customer of the quality.

Liability claim

At this point the welding defect for example with low penetration will cause significant costs. If the deviation is recognized early enough the manufacturer is able to send qualified welders for repairing work.

3 Value impact of welding management software throughout the welding production chain

The use of welding management software affects multiple points on the welding production chain creating value impact on several levels. The following figure shows the identified improvement areas welding management solution is able to touch upon.

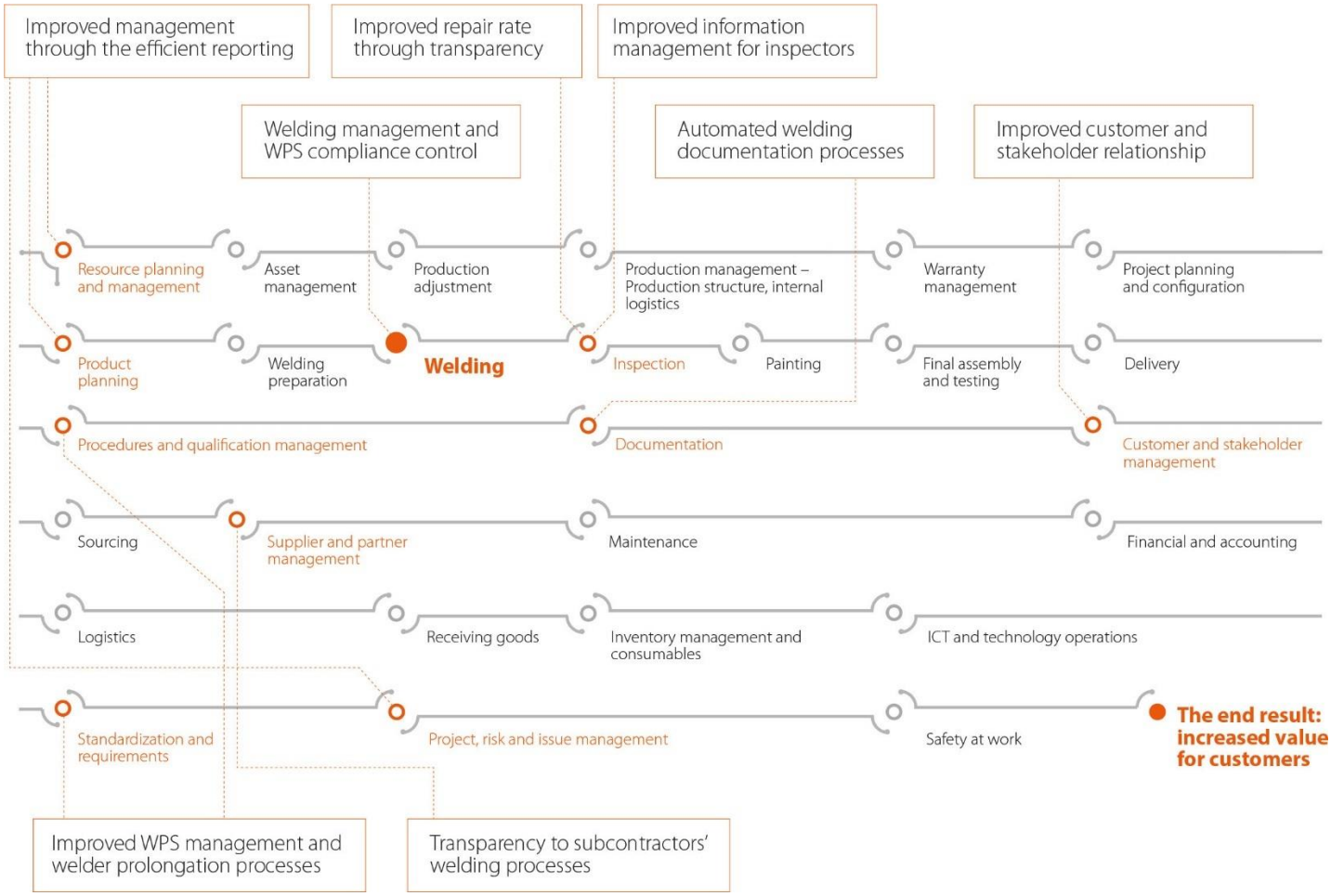

Figure 2: Value impact of a welding management software throughout the welding production chain

3.1 Case Example

For this white paper we are using an example dataset from a midsized machine shop with 35 welding machines in use. The shop has a workforce of 35 welders for each shift, working 8 man hours in two shifts. The hourly cost for a welder is 21,00 EUR and 28,00 EUR for a welding coordinator. Before utilizing a welding management system the company documents approximately 5 percent of the welds.

Welding

Welding management systems provide a comprehensive and automated way of documenting welds. This provides multiple benefits: it improves the quality control significantly – our example company is documenting 5% of the welds before utilizing the WMS and 100% after the system is in production. The documentation process is automated, removing the previously manual, slow and error-prone tasks completely. The ability to locate correct WPSs quickly and verify the welder qualifications effortlessly reduces the hours spent on welding coordination. Documenting all welds based on digitally collected data provides complete traceability and creates value by removing the time spent on documentation and reducing the rate of welding defects caught in later stages of the production process. As the repair actions are reduced altogether, the arc-on time is improved, speeding up the overall welding production time.

Welding documentation

Welding documentation gathering is one typical task before the product is ready for user acceptance. In project business, documentation gathering is one obvious work phase that does not refine the end product at all and therefore can be recognized as a wasted time. In the example below the manufacturer owns 70 different projects in a year and used seven persons for two in documentation purposes after the project. Without a welding management system, the overall time for documentation in a year is 6950 hours. A versatile welding management system contains a document register functionality that selects correct documents, including welder qualification certificates, material certificates, CAD drawings etc. based on your project number without any labor-intensive manual work. Welding documentation is therefore one working phase with notable saving and value potential. With a welding management solution, the manufacturer reduced documentation time by 75%. The achieved value potential was over 145 000 € in year.

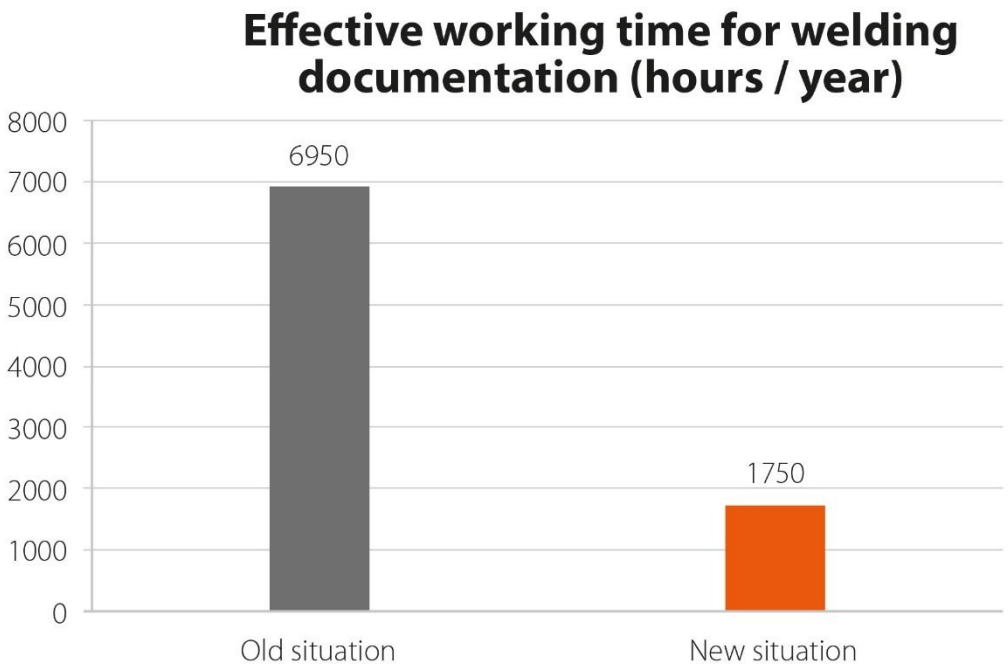

Figure 3: Effective working time for welding documentation

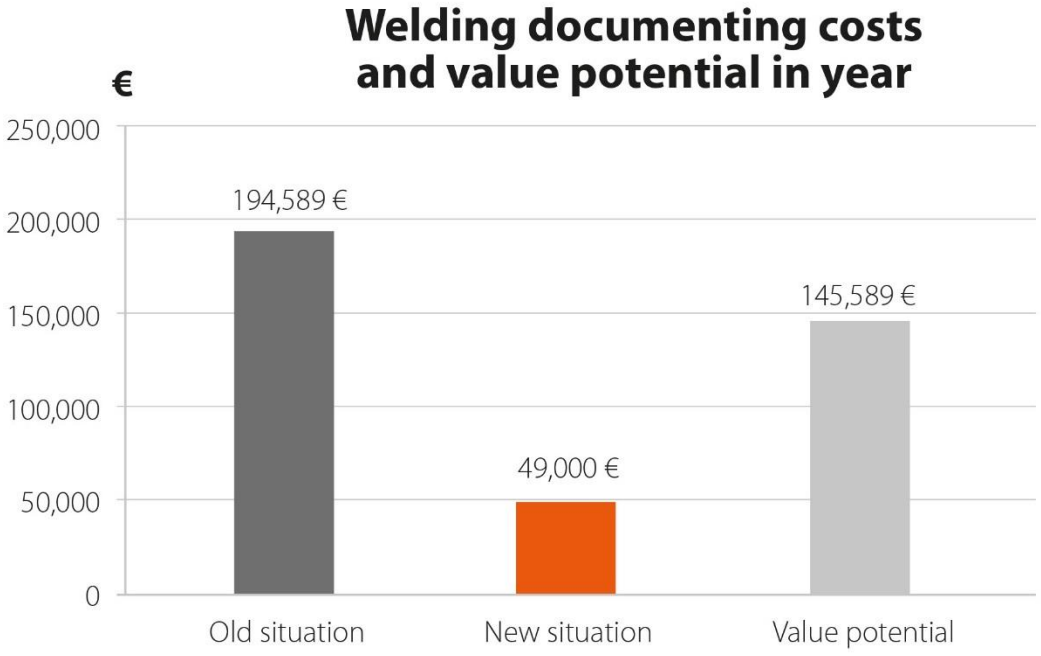

Figure 4: Welding documenting costs and value potential in year

Decreased repair rates

Utilizing a welding management software creates value by decreasing the overall repair rates. As the cost to repair a weld is approximately 400€/m, this creates value by direct cost savings. The reduced repair rates result in improved arc-on time ratio, which in turn decreases the time needed for the whole welding production process.

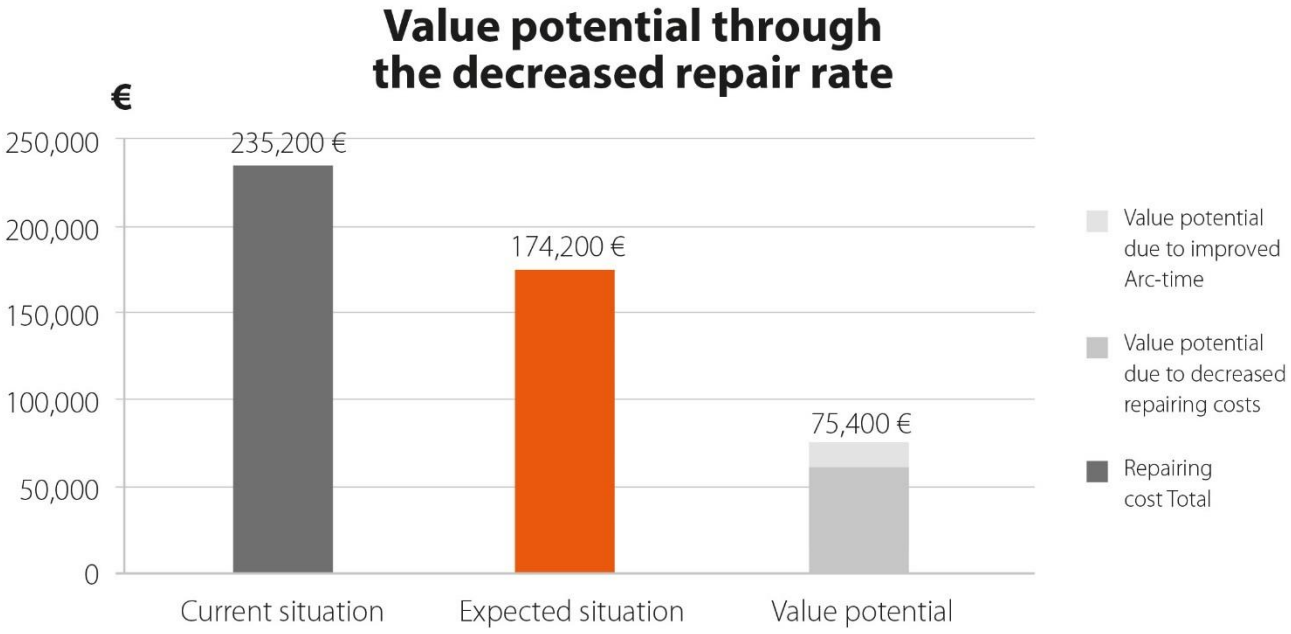

Figure 5: Value potential through the decreased repair rate

4 Total cumulative value impact

The value potential areas are different for each manufacturer depending on their existing situation, production type and location. For each company and scenario we can calculate the overall value potential of utilizing a welding management software and the actual expected value which takes the companies own estimation of success rate into account. For our example scenario we calculated the following value potential.

To generalize the results more we have gathered data from approximately 50 welding management system scenarios and found that the value potential for each aspect of the welding process is the following as presented in Figure 6.

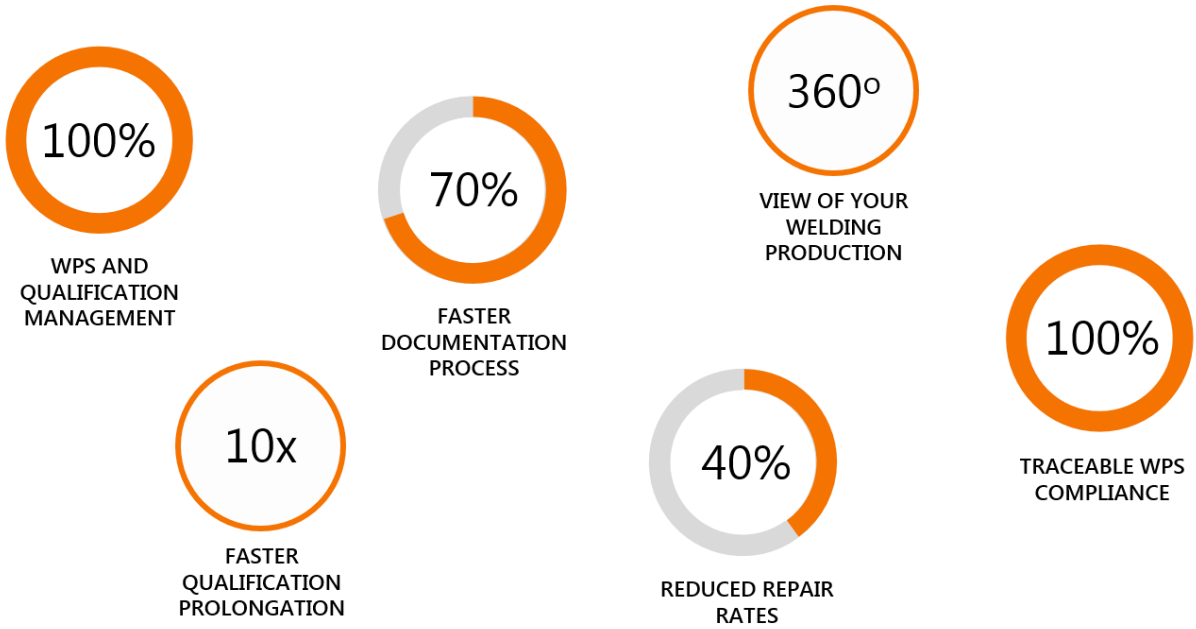

Figure 6: Value potential for welding process aspects

For our example scenario we used the calculations presented in Table 1 to estimate the actual expected value for taking the welding management software into use.

Table 1: Case Example Value Potential Calculations

Function	VALUE POTENTIAL	Share %	Probability
Value potential through the decreased repairing cost in third party inspection	55 560,96 €	21,58%	100%
Value potential through the decreased repairing cost in welder's visual inspection	5 376,00 €	2,09%	100%
Value potential for improved arc-time instead of repairing work	14 505,96 €	5,63%	100%
Value potential through the improved welding documentation process	145 600,00 €	56,55%	50%
Value potential through the improved welder prolongation process	3 822,00 €	1,48%	50%
Value potential through the improved WPS management process	32 613,33 €	12,67%	70%
Total	**257 478,25 €**		

Function	VALUE POTENTIAL	Share %	Propability
Value potential through the decreased repairing cost in third party inspection	55 560,96 €	30,29%	100%
Value potential through the decreased repairing cost in welder's visual inspection	5 376,00 €	2,93%	100%
Value potential for improved arc-time instead of repairing work	14 505,96 €	7,91%	100%
Value potential through the improved welding documentation process	71 540,00 €	39,00%	50%
Value potential through the improved welder prolongation process	3 822,00 €	2,08%	50%
Value potential through the improved wps management process	32 613,33 €	17,78%	70%
Total	183 418,25 €		

Based on the probability estimations on the realization of the full potential we can safely estimate that the estimated cumulative value of utilizing welding management software is as presented in Figure 7.

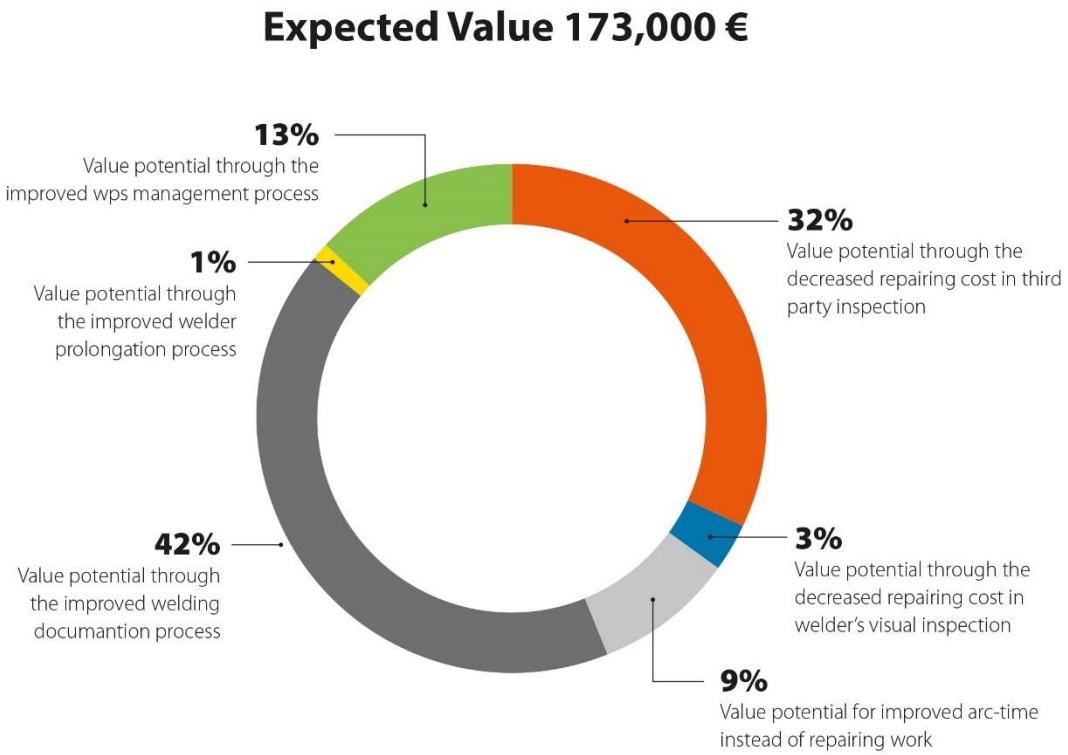

Figure 7: Expected Value

5 Key learnings

As the research concerning the transparency of subcontractor supply chains shows, the ability for a subcontractor to provide accurate data on different production processes is a competitive factor now and even more so in the future. Single companies form collaborative networks to boost this ability further and to create value for the manufacturing industrial client. At the same time the subcontractors are able to optimize their own processes by utilizing new digital tools. For welding process this means the use of new solutions for welding management.

The data in this white paper shows that the two major value generating features provided by a welding management software are the ability to automate the documentation process related to welding and catch defects on an earlier stage. Both of these abilities cumulate the value by improving the arc-on time and reducing time spent on welder qualification certificate and welding procedure management.

For our example case we calculated that the expected value (weighted value potential) of utilizing a welding management software would provide a yearly expected value of over EUR 173,000 resulting in a break-even for the investment in *eight months* from the rollout. Knowledge in welding production generates substantial value impact.

About the authors

Author Kari Kemppi is Director of Software Customer Operations at Kemppi. He has worked with Kemppi for more than thirthy years, managing Supply Chain, developing Welding Management Solutions and leading a Kemppi-owned software company. He holds M. Sc. (Eng.) on Computer and Software Engineering from Tampere University of Technology and a B. Sc on Measurement and Control Electronics.

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