



Boyan Ivanov<sup>1,a</sup>, Stanislav Wiens<sup>1</sup>

# IMPLEMENTATION OF A WELDING 4.0 WELDING QUALITY MANAGEMENT SYSTEM EXPLAINED ON REAL APPLICATIONS IN MANUFACTURING AND EDUCATION

## IMPLEMENTACIJA SISTEMA UPRAVLJANJA KVALITETOM ZAVARIVANJA WELDING 4.0 PRIKAZANA NA REALNIM PRIMENAMA U PROIZVODNJI I OBRAZOVANJU

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### Abstract

Discovering savings potentials, ensuring cost-effective manufacture and documenting every weld are three requirements, which couldn't be more different. It is precisely in quality assurance and quality management where documentation is increasingly gaining in importance. For welding companies, this entails making a record of the different welding parameters. In conventional work practices, the relevant values are written down by hand. Most of these values are hold values, which are displayed on the machine at the end of the welding process. However, such values do not provide any indications on how the parameters have changed during the welding process. Modern Welding 4.0 systems not only meet almost all requirements for a quality assurance documentation system, but provide much, much more. Welding 4.0 systems record and log all welding parameters on a continuous basis, something, that is becoming mandatory on an increasingly more frequent basis. The data can be used to demonstrate at any time that required parameters have been met and that the weld features the required characteristics as a result. In addition, the recorded data can be used for exact calculations on manufacturing time or material consumption, as well for starting optimization processes and management decisions. The Paper shows and explains the basic principles of Welding 4.0 systems and explains the benefits on real examples from the welding manufacturing and welding education.

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**Adresa autora / Author's address:**

<sup>1</sup> EWM AG, Günther-Henle-Str. 8, 56271 Mündersbach, Germany

email: <sup>a</sup> [boyan.ivanov@EWM-group.com](mailto:boyan.ivanov@EWM-group.com)

**Ključne reči:** digitalizacija, zavarivanje, obezbeđenje kvaliteta, upravljanje kvalitetom, WPQR, WPS, koordinator zavarivanja, inspektor zavarivanja

### Rezime

Otkrivanje potencijala ušteta, obezbeđivanje isplative proizvodnje i dokumentovanje svakog zavara su tri zahteva, koji ne mogu biti drugačiji. Upravo u osiguranju kvaliteta i upravljanju kvalitetom dokumentacija sve više dobija na značaju. Za kompanije koje se bave zavarivanjem, ovo podrazumeva vođenje evidencije o različitim parametrima zavarivanja. U konvencionalnim radnim praksama relevantne vrednosti se zapisuju rukom. Većina ovih vrednosti su vrednosti koje se zadržavaju i koje se prikazuju na mašini na kraju procesa zavarivanja. Međutim, takve vrednosti ne daju nikakve indikacije o tome kako su se parametri promenili tokom procesa zavarivanja. Moderni sistemi za zavarivanje 4.0 ne samo da ispunjavaju skoro sve zahteve za sistem dokumentacije za osiguranje kvaliteta, već pružaju mnogo, mnogo više. Sistemi zavarivanja 4.0 sakupljaju i beleže sve parametre zavarivanja na kontinuiranoj osnovi, nešto što sve češće postaje obavezno. Podaci se mogu koristiti da se u bilo kom trenutku pokaže da su ispunjeni traženi parametri i da zavareni spoj kao rezultat ima tražene karakteristike. Pored toga, snimljeni podaci se mogu koristiti za tačne proračune vremena proizvodnje ili potrošnje materijala, kao i za pokretanje procesa optimizacije i donošenje upravljačkih odluka. U radu su prikazani i objašnjeni osnovni principi Zavarivanje 4.0 sistema i objašnjene su prednosti na stvarnim primerima iz proizvodnje pri zavarivanju i za obrazovanje u zavarivanju.

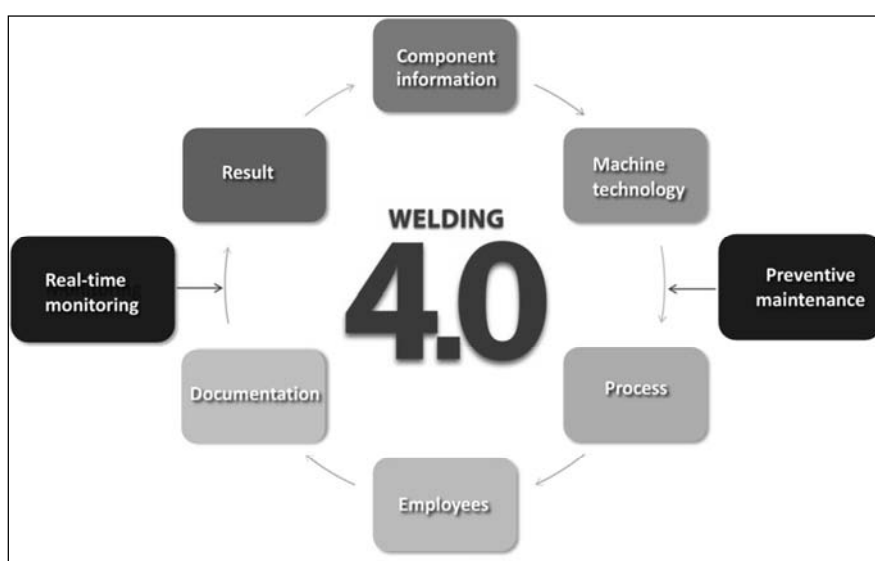


## Introduction

Making Industry 4.0 a reality can be easy – no matter your company's size or focus. The benefits are as clear as day: Strengthened interconnectedness of products and people increases efficiency and quality, while reducing costs and preserving resources. Welding companies are adding measurable value throughout the company's entire value chain. Thanks to intelligent monitoring and transparent planning, production, quality management, welding coordination personnel, final costing and administration processes, one can always keep track of everything.

## 1. Analysing, controlling and managing welding processes

Discovering savings potentials, ensuring cost-effective manufacture and documenting every weld are three requirements which couldn't be more different. The modular quality management software EWM Xnet helps to unite these three tasks in a single solution, thus benefiting both small welding firms and major global corporations. EWM Xnet is fully compatible with Industry 4.0, a German government computerisation project, and already supports networking for complex manufacturing sequences – from mass production to a one-off single item.



**Figure 1.** The quality circle in welding technology

**Slika 1.** Krug kvaliteta u tehnologiji zavarivanja

## 2. Documentation – yesterday and today

It is precisely in quality assurance and quality management where documentation is increasingly gaining in importance. For welding companies, this entails making a record of the different welding parameters. In conventional work practices, the relevant values are written down by hand. Most of these values are hold values which are displayed on the machine at the end of the welding process. However, such values do not provide any indications on how the parameters have changed during the welding process. EWM Xnet not only meets all requirements for a quality assurance documentation system, but provides much, much more.

EWM Xnet records and logs all welding parameters on a continuous basis, something which is becoming mandatory on an increasingly more frequent basis. The data can be used to demonstrate at any time that required

parameters have been met and that the weld features the required characteristics as a result. Figure 1 shows the connection between the different components related with the quality in welding.

## 3. Documentation of all machine data

EWM Xnet is a component within EWM's Multimatrix technology. As all components in the overall welding chain come from a single source, they can also be optimally matched to one another. This is why EWM Xnet not only logs the two parameters welding current and welding voltage as is the case with machines customary in the trade. EWM Xnet also accesses the machine data itself and logs all relevant parameters (Figure 2). In addition to the two performance data current and voltage, this also includes the arc energy, wire feed speed and JOB number, including header data on wire characteristics such as wire material and wire diameter. Logging of all relevant machine data with



EWM Xnet is used for quality assurance. Changes to the armature current during wire feeding, for example, may indicate imperfections which can

cause the contact tip or the liner to clog. It is not possible to detect such problems if only the current and voltage are logged.

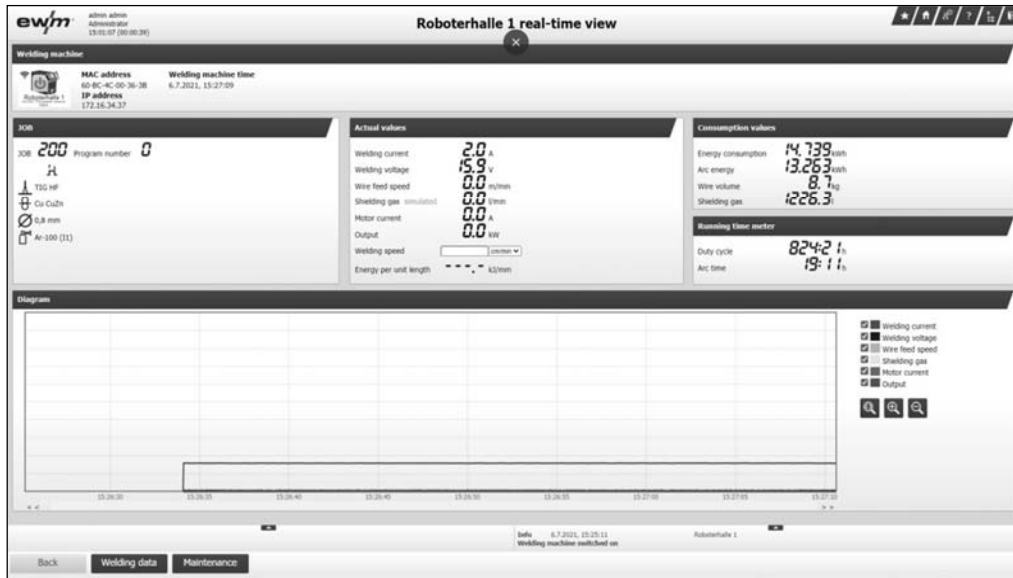


Figure 2. EWM Xnet server

Slika 2. EWM Xnet server

#### 4. Savings potential on replacement parts

Wear is a subtle process. Changing replacement parts too early pushes up costs: first of all, a component which is still functional is replaced and, secondly, replacing the part takes up work time which could be spent on production. On the other hand, if replacement parts are changed too late, it can bring about sudden production downtime and cause wastage. Changing replacement parts in good time, but not too soon means savings potential for any company.

Wear changes welding parameters only slightly at a slow pace. Such changes are not obvious when looking at data. As EWM Xnet logs all machine data, the software can also access this

data. Parameter limits indicate the optimum time to fit replacement parts. Replacement parts are thus not fitted after a pre-determined number of cycles, but when it becomes necessary. This saves time and money.

#### 5. Analysing non-productive times

Non-productive times can be analysed thanks to the distinct classification for welds, welding times and components. The duty cycle and effective welding time for each individual machine can be contrasted. If the ratio of the two values is very low, this can indicate that non-productive times are too long. EWM Xnet helps to detect non-productive times, thus revealing savings potentials in the production sequence (Figure 3).

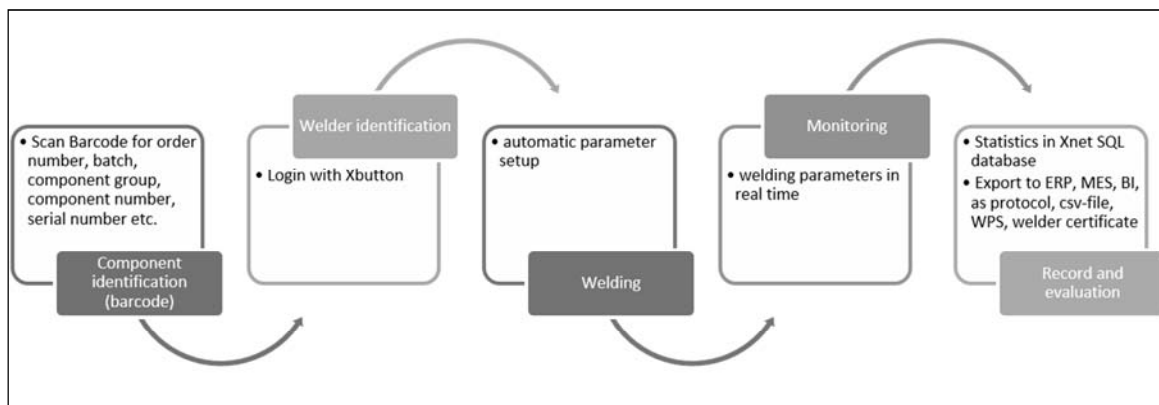


Figure 3. Savings potentials in the production sequence

Slika 3. Potencijali uštede u proizvodnom nizu



## 6. Maintenance – precisely scheduled and as per standard

Servicing and maintenance must be carried out on both a regular and irregular basis. Coolant is changed on a regular basis after one year, but wire feed rollers have no foreseeable precise replacement date. This is because their need for replacement depends on many different parameters, such as period of use, material diameters and conveying speed. EWM Xnet features setting options for both regular maintenance, as in the case of coolant, and non-regular maintenance for items such as wire feed rollers. What's more, these settings can be made for each welding machine on an individual basis. Regularly reoccurring maintenance cycles can be configured with scheduling instructions and plain text information as can a message indicating that wire feed rollers need to be replaced.

EWM Xnet displays a suitable alert message on the screen at the right time, perfectly clear in plain text. Information is delivered where it is needed, that is to say, to the welder or the welding supervisor who coordinates maintenance or servicing. Adjusted maintenance and servicing cycles ensure production is planned with foresight, which, in turn, increases product quality. This also

means that the requirements specified in EN 1090 or EN ISO 3834 is met. Clearly documented maintenance procedures can also make costs transparent and allow them to be incorporated into calculations.

## 7. Final costing – not a closed book

A quote is easily drawn up with the calculated values based on data drawn from experience. But do they truly reflect reality? Final costing does not present a problem with EWM Xnet, no matter whether you have one or several components, a larger production lot or even a whole production line. What's more, it does not depend on the number of welding machines involved in completing the order.

Before starting an order, the counter readings on the machines used are set to zero for the following consumption items: welding consumables, shielding gas and electricity (Figure 3 and Figure 4). Once work is complete, EWM Xnet automatically displays the cumulative values. The overall consumption rates for consumption items are immediately available. These values can also be broken down for each individual machine or group of machines – when different production plants or lines need to be compared with one another, for example.



*Figure 4. Welder scans the barcode on the component using a barcode scanner*

*Slika 4. Zavarivač skenira bar kod na komponenti koristeći bar kod skener*

## 8. Software compatible with all user interfaces

EWM Xnet is web-based and compatible with all operating systems. Once the program is installed on the company's own server, it can be accessed by all machines linked to the server in a similar way to a website. Devices include fixed PCs, laptops, tablets and smartphones.

Having EWM Xnet available on PCs or laptops at workstations is certainly recommendable for daily work. welding procedure tests, it can also be beneficial and practical to stand directly next to the welder with a tablet and track data in real time in graph format. Production sequences and welding process plans can be optimised during process or



product development. Data is not only available on the tablet, but can also be accessed on all other PCs, both online and at a later point in time.

If evaluation software has already been established for operations, EWM Xnet transfers the recorded data to this system, where they can be further processed as required.

### 9. Personalised users

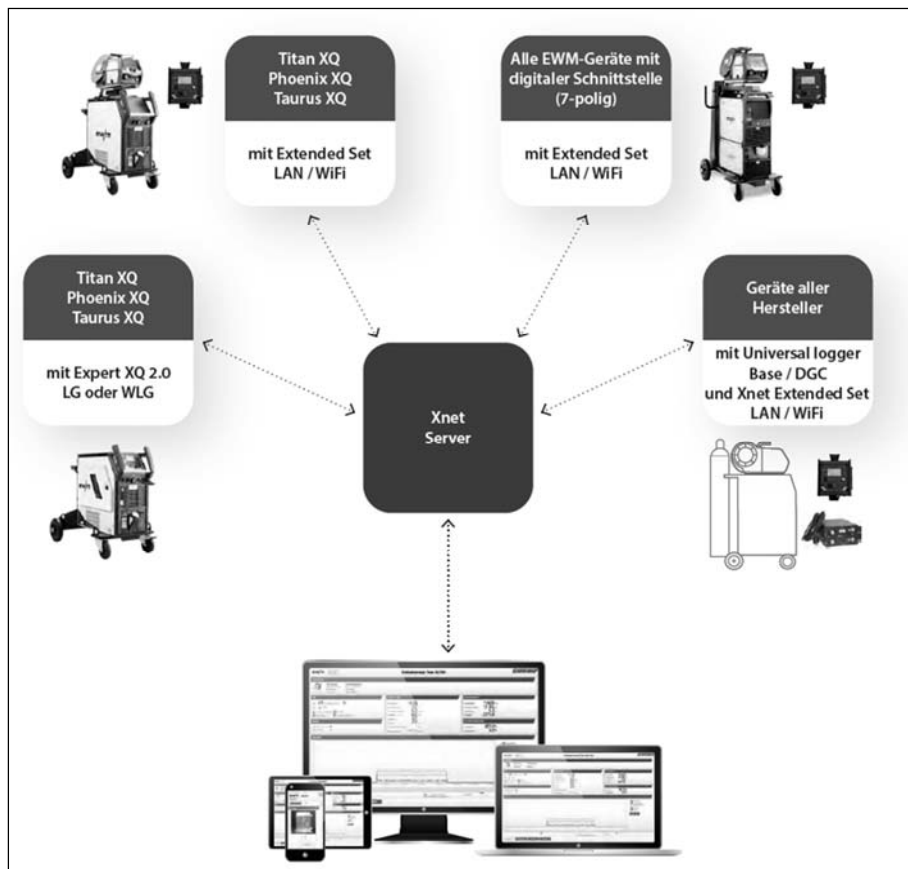
Different users can be provided with different access rights in EWM Xnet. This applies to the actual access rights themselves as well as to the number of machines which may be accessed. Supervisors can gain access to machines that they are responsible for. It can be useful for product planners to compare different product lines with one another and they therefore receive access to all machines in production. Administrator rights cover user management, including issuing user rights on an individual basis, plus machine management and integration of new machines.

### 10. New machines – easily integrated with drag and drop

Machines are displayed in both a list and on a site plan in EWM Xnet. The site plan is entered as a diagram and shows the individual locations where welding machines are installed. The drag and drop function allows you to move new machines into the position where they are to be used, usually a welding booth. If the position of this machine should be permanently changed at any time, the site plan can be easily adjusted accordingly.

A site plan offers a decided advantage over table format as people are generally more familiar with the location of the machine than its exact name. This makes it easier to correlate.

Data from machines is transferred to the network online via LAN or WLAN (Figure 5) or offline using a USB flash memory. If a machine is outside the network, the data is logged offline. Data is transmitted to the network either when the machine logs into the network when it is next online or using a USB flash memory which uploads the data from the machine.



**Figure 5.** The Xnet connection to welding machines with integrated networking options and innovative welding process controls

**Slika 5.** Xnet veza sa aparatima za zavarivanje sa integrisanim opcijama umrežavanja i inovativnim kontrolama procesa zavarivanja



## Conclusion

EWM Xnet is easy to use and operated intuitively, but will still meet all requirements for complex production sequences, including implementation of Industry 4.0. Transparent display of production sequences discloses ineffective work times and results in optimum work processes, leading to savings potential. Quality is also assured as each weld can be monitored on a continuous basis.

Optimised work processes and high quality standards mean more money coming in. Both small firms and big corporations who use EWM Xnet thus remain competitive.

## Zaključak

EWM Xnet je jednostavan za korišćenje i njime se upravlja intuitivno, ali će i dalje ispunjavati sve zahteve za složene proizvodne sekvence, uključujući implementaciju u Industriju 4.0. Transparentan prikaz proizvodnih sekvenci otkriva neefikasna vremena rada i dovodi do optimalnih radnih procesa, što dovodi do potencijala uštede. Kvalitet je takođe osiguran jer se svaki zavar može kontinuirano pratiti.

Optimizovani radni procesi i visoki standardi kvaliteta znače više novca. I male firme i velike korporacije koje koriste EWM Xnet na taj način ostaju konkurentne.

## References / Literatura

[1] <https://www.EWM-group.com> (2023)

## Članstvo u strukovnoj asocijaciji DUZS

je referenca za Vaš profesionalni status

Članarina za 2024. godinu je 3500,00 dinara

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### Informacije



+ 381 (11) 2420-652 (10-16 h)



[duzs011@gmail.com](mailto:duzs011@gmail.com)

[www.duzs.org.rs](http://www.duzs.org.rs)