

A Simple Introduction to the World of Q-DAS® and the CAMERA Concept

A not totally made-up report on my experience

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Presentation

May I present myself? I work in the field of quality assurance. My company produces shafts.

Different machines produce these shafts. My shaft has got five points (characteristics) I have to inspect in order to find out whether everything is alright.

There are different suppliers, different machine operators and different appraisers for the material, but more on that later.

I use a caliper in order to inspect my shaft. At the push of a button the caliper shows me the measured value of the respective characteristic and I write it on a piece of paper.

I know, this does not sound like the best practice for quality assurance.



Figure 1: My shaft

Is my Measuring Equipment Capable? Capability of measuring equipment -> solara.MP

This is the first time I encounter the world of Q-DAS®: If I want to measure a certain quantity, I have to make sure that my measuring equipment works precisely enough to do so.



Figure 2: My caliper

This is when it comes to the capability of measuring equipment; and it is this capability that I need to know.

So I want to use the solara® software helping me to make different analyses easily. Eventually I will receive a report providing an overview of all the important pieces of information I need to know.

This report shows a green smiley at best. Always.

Now I am able to evaluate my measuring equipment. I inspect it at regular intervals. And I can rely on the calculations made by the software.



Figure 3: Evaluation results for measuring equipment

The results are correct and validated.

So I have to take a closer look at my process now. And I have to deal with these C_p and C_{pk} values that everyone is talking about...

"I have to establish the capability of my measuring equipment continuously to perform the desired inspection task. solara shows me the capability in a clear and simple way."

C_m ? But I Wanted to Calculate C_p !

Machine capability -> qs-STAT®

Everybody talks about process capability...

However, I have just checked whether my measuring equipment is able to measure correctly, so I should also check whether my machines are able to produce my parts.

The magic word is machine capability analysis.

Q-DAS® refers to this type of analysis as a sample analysis. The capability index - a kind of "grade" for the machine- is called C_m/C_{mk} .

I check whether my machine is capable in one go by using a single sample and as few influence components as possible.

I measure 50 parts that have been produced successively.

Then I enter the measured values in qs-STAT®. Now I tap <F10> and, lo and behold, the machine is capable.

qs-STAT® selects the correct and best suitable calculation method for my measured values automatically.

I do not have to be a statistician in order to use this software but, if I want to, I may adjust everything in the minutest detail.

"I use qs-STAT® in order to perform sample analyses and process analyses. I check whether my machine is capable of producing the desired parts."

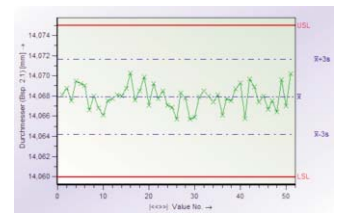


Figure 4: Machine capability 50 values

$\hat{\mu}$	0	$\hat{\sigma}$	0.00000%
$\hat{\sigma}$	0	$\hat{\mu}$	0.00000%
$\hat{\mu}_{\text{ref}}$	100		
$\hat{\sigma}_{\text{ref}}$	100		
Characteristics Class	significant		
Model distribution	Normal Distribution		
Calculation method	M1 (s) Percentile (0.135%-99.865%)		
Potential Capability index	C_m	$1.73 \pm 2.01 \pm 2.29$	1.67
Critical capability index	C_{mk}	$1.63 \pm 1.90 \pm 2.17$	1.67
The requirements were met (C_m, C_{mk})			
Demand Potential Capability index	$C_{m\text{target}}$	1.67	
Demand Critical capability index	$C_{mk\text{target}}$	1.67	
Q-DAS Machine Capability (05/2013)			

Figure 5: Machine capability analysis

How Well Does My Process Work?

Process capability -> qs-STAT®

Capable. But what does that mean anyway?

We produce 100 shafts a day. I cannot inspect all of them in a measuring room.

I only inspect five of them but I need software that tells me the quality of the remaining 95 parts based on the measured values of these five shafts. That is statistics.

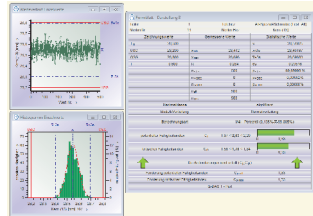


Figure 6: Process analysis

However, before these few shafts are able to provide information about my current process, I have to become thoroughly acquainted with the process first. Three shifts measure five shafts for ten days. Based on this "amount" of values I am able to check whether the process is capable to produce the shafts.

qs-STAT® does that for me. The software calculates e.g. the capability index "C_{pk}" from my measured values. This index is like a school grade, the higher the better. And if this index even exceeds my demands/my target value typically amounting to 1.33, my process will be "capable".

Short example: If I analyze my samples and this analysis leads to a C_{pk} of 1.67, statistics says that I have to expect 0,63 erroneous parts out of one million parts produced.

Result: Not even one part will be defective. I can live with that.

Once again: Even though I just measure few parts, qs-STAT® draws conclusions about all parts. The software reaches these conclusions automatically and, just as the Sample Analysis module does, selects the correct calculation methods, but more on that later.

By the way, the method used to calculate the capability index and the reason why it refers to the number of errors per million (parts per million, ppm) is a different and complicated subject. The TEQ® offers trainings in this topic area. They are the experts in training and consulting of the Q-DAS® Group. You may either participate in a certain training course or invite an expert to your company. This seminar will then be adapted to your needs and requirements.

"qs-STAT® helps me to understand my processes. I am able to control, monitor and analyze."

I Need Measured Data, as Easily as Possible.

Recording measured values -> procella®/O-QIS procella®

My system grows. My measuring equipment is capable. My machines are capable. We produce.

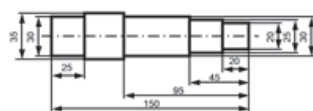


Figure 7: Drawing from development

I would like to check my products continuously now.

Thus my appraisers shall inspect the shafts taken from the production process.

In this case, qs-STAT® is not the ideal software

solution. I want my appraisers, who did not receive any training in using the software, to be able to enter measured data easily. The data should refer to the respective test part and be entered in the correct sequence. It will be perfect if my appraisers receive exact images, instructions and information about where to measure the part.

And this is procella®.

First I create a test plan. Then I determine the measurement sequence. Now I define the characteristics and I am geared to my drawing from the development department.

These tasks are quickly to fulfill and procella® does all the rest.

In version 10, you may even stamp CAD drawings automatically, i.e. transfer measuring points / characteristics from the development drawing automatically.

The old piece of paper that I wrote the measured values on has long vanished in the bin. Electronic data recording has got great advantages.

Here I have got the option to save images and drawings for each characteristic. Even untrained operators are able to take the measurement correctly.

In the course of time I realize that I would like to append additional information to the measured value. I have already recorded date/time but I would like to add batch and machine. That is not a problem.

The past is already forgotten: At the beginning we entered measured values manually. Now, one of the strengths of procella® is the connection to measuring equipment. The latest list of interfaces includes more than 200 current measuring instruments that can be connected to procella® directly and the number still rises.

In the meantime, we have connected several feelers and calipers, of course, to procella®.

Push the button and the measured values are recorded.

procella® jumps to the next characteristic to be recorded automatically.

By the way, the feeler on the picture was not contained in the list of interfaces.



Figure 8: procella input mask



Figure 9: Connected measurement system

In these cases, Q-DAS® creates a new connection.

“procella® can visualize any measurement procedure, however complex it might seem. As an additional support, I may integrate photos and drawings.”

I Want to Find Information More Easily!

Files vs. database -> Q-DBM

We work with files all the time. This is reasonable when performing measuring system analyses (solara®). However, you will lose track of your process data someday.

Q-DAS® always installs an Access database providing storage space for several millions of measured values and it is still free of charge.

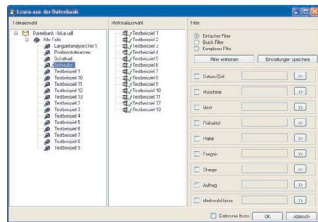


Figure 10: Database and filter

The great advantage:

Each program, no matter if it is solara®, qs-STAT® or procella®, can load data directly from the database.

I may define the display of test plans individually.

So I will find my parts more quickly.

If I am only interested in the production data of the last month and only the values of machine 1 and batch 4 are important, I can filter the information.

I have got the option to save these filters and even selections which makes working faster.

Someday, the Access database might not provide enough storage space anymore. Now, MS-SQL or Oracle comes into play. And Q-DAS® offers Q-DBM, the database module in order to connect a “real” database.

And by the way:

I was able to directly import my old Excel file that I still had from pre-Q-DAS® times by using an import tool. I could also have done it by copy & paste but the import seemed more elegant to me.

“Working with databases makes it easier to find data and provides the option to work with advanced filters.”

My Measuring Machine Communicates with Q-DAS®: Let’s Pass the Data!

Connecting measuring machines -> O-QIS CMM

The system continues to grow. Several measuring machines are in the measuring room. Their providers are certified by Q-DAS®, i.e. the machines are able to write the Q-DAS® transfer format.

Files in the Q-DAS® transfer format are small text files containing the mea-



Figure 11: O-QIS CMM

sured value, test plan information and any further information provided by the measuring machine.

At the beginning, we sent these files to the database by using the Upload Client, a little Q-DAS® tool that is free of charge. This service just searches for the best suitable pigeonhole in the database and saves the measured values there.

However, in the course of time, you would have been happy if erroneous measurements had not been saved to the database at all or if additional information had been appended to the measured values as procella® does.

This is when O-QIS CMM can help.

(Even though this piece of information might be confusing: O-QIS is the main product and includes several modules, namely procella®, CMM, Alert Manager and Monitoring. However, procella® can also be purchased as an own product.)

We installed O-QIS CMM between the interfaces of the measuring machine and the Upload.

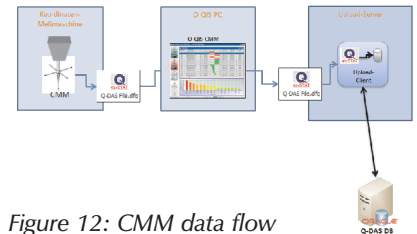


Figure 12: CMM data flow

As soon as the coordinate measuring machine (CMM) takes a measurement, the measured values are immediately displayed in O-QIS CMM. There you find two buttons, a red one and a green one. Use these buttons to evaluate the measurement easily and quickly and decide whether you want to upload the data into the database. Now we have O-QIS installed at every measuring machine.

A new task for the appraiser is now to confirm the measurement.

This task leads to useful measured values in the database and it does not matter whether they are inside or outside the tolerance.

It is very easy to use the software. You may even activate the input of additional data. Everything is possible.

“Due to O-QIS CMM, measuring machines are integrated perfectly into the system. In addition, the measured data are evaluated.”

Who Is Allowed to Delete My Measured Values?

Rights management in the world of Q-DAS® -> all products

Initially, we had local installations. This was sufficient. However, by using a central database we were also searching for an option to manage user rights centrally.

In the user management you may define groups and assign specific rights to these groups. As an example, we have the “appraiser” group whose members are actually only allowed to measure.

The members of the “process responsible” group have much more rights, e.g. they are allowed to create test plans.

I do not have to create every single new user anymore since I can use the “Use Windows registration” option. Due to this option new users are created automatically when they sign in for the first time. Then I move the new users to the respective group. Ready.

More and More People Want to Be Part of It Single & concurrent licenses -> all products

In order to save costs, we removed our single installations (stand-alone) and decided to purchase the concurrent version (floating) instead. So we use a server installation now.

This server installation knows that we own a certain number of “floating” licenses per product. Thus we may install the client installation on any computer but the number of users working with the software at the same time cannot exceed the number of licenses we purchased.

In the meantime, we have got a qs-STAT® plant license. This means that we may use qs-STAT® as often as we like at our site.

If we require an additional license for a product, we order it and receive a small license file that we can easily load on a central server.

Everything under Control!

Control loops in the world of Q-DAS® -> procella® & qs-STAT®

In addition to the recording of measured values and the overall evaluation of our processes, which is also referred to as a major control loop, the graphical user interfaces of our recording programs were adapted in a way that control charts and additional information are displayed to the operators while taking measurements.

Thus we implement the minor control loop that helps our operators to control the machines directly since they only have a short-time slot available.

Action limits from different calculated control charts show operators when a process changes and when they actively need to take corrective action in the process.

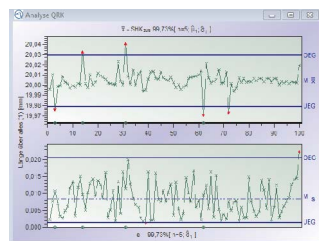


Figure 13: Control chart

You may calculate the control charts automatically or specify them manually.

This is also done on a central server since you would not want to walk from workstation to workstation and adjust the respective settings there.

In case the specification limits are violated, the machine operator has to select an event, e.g. “tool breakage”. We now gain more and more measured values including

additional information helping us to make evaluations. *“O-QIS procella and CMM do not only suit the purpose of data recording, but also help us to evaluate and hence to control the machines directly.”*

I Need Own Reports. And I Want to Include My Corporate Identity.

Report design adapted to your needs ->Form Designer (Q-FD)

The reports provided by the software have been adequate for a long time.

Someday, customers and other departments had additional requirements.

The Form Designer gives us the option to create own reports or to change existing ones. You may even embed graphics and drawings, e.g. an overview of all measurement points including a drawing of the part showing the location of all the measurement points.

You configure individually how the information contained in the report is displayed. You may even combine summaries of parts, data related to characteristics and single lists of values as requested.

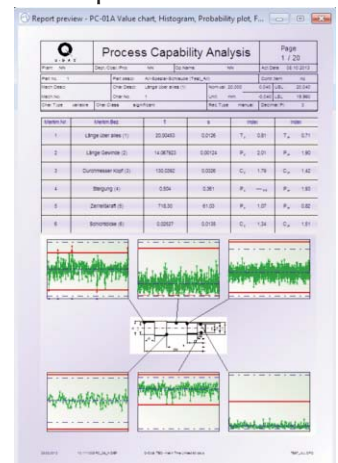


Figure 14: Customized report

More Communication between Measuring Room and Machines Required.

Two-stage CMM ->O-QIS CMM

Another improvement. We introduce a new intermediate step for the measuring machines. Do you still remember? The measuring machines used to send their data to the O-QIS software in the measuring room so far. There the data were received and transferred to the database automatically by using the Upload.

However, our problem was that the information from the measuring room hardly ever reached the machines. The operators delivered the part to be measured to the measuring room. And what happened then?

Now we have changed this procedure. We installed O-QIS workstations at the machines so that the whole procedure has been modified: Depending on the machine producing the part to be measured, the measuring machines in the measuring room do not send their measured values to the Upload but send them to the second chain of O-QIS installations first, directly to the corresponding machine.

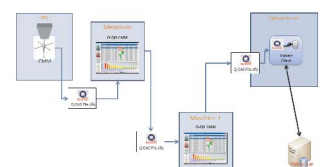


Figure 15: 2-stage CMM data flow

Hence, the operator, who has just delivered his part of machine 1 to the measuring room, promptly receives the measured value and the value chart of his part since they are displayed at his machine. Now he is able to make adjustments, if required.

The kind of evaluation the operator makes changes. Now, the inspector in the measuring room only evaluates the quality of the inspection. Measured correctly, correct test plan.

And the operator at the machine may add additional information, e.g. the reason why and how this measured value was recorded and which corrective action he wants to take now. Tool breakage, machine readjusted, etc. The information is flowing...

“QIS-CMM is applied flexibly. A better communication between measuring room and machine raises the significance of your measured values and leads to shorter response times.”

How Warm Was It?

Process data from machines ->all products

The free-of-charge Upload Client allows you to load data available in the Q-DAS® transfer format automatically into the database. We have managed that our in-house tester system is able to create these data. The data format is described quite well and always disposable. Thus we are able to combine machine data with measured data.

As an example, we record temperatures and other machine parameters at the time of producing a part and save this information to the database. We determine correlations when comparing these data to our measured values. But don't worry, qs-STAT® will do that automatically for you.

However, it is important to have a clear allocation of data. In our case, this is a unique ID number identifying the machine and the measuring station. Now we gain significant information about each part.

Q-DAS® or any Q-DAS® partner may also connect the machines to O-QIS. They write converters to be implemented into the Upload Client. After the implementation is completed, your system can read any file format. And by the way, the program already includes an Excel and CSV converter.

Punctually at 8 A.M. the Report Is on the Table!

Automated reporting system ->M-QIS Reporting

Maybe “intermediate result” is the better heading. Our data stream flows all the time. Our information is valuable. We regulate and control directly at the machines and in a more comprehensive way in order to keep and improve our quality standard.

I got some new projects and I have only a short time left to create reports on a daily basis, even though different

departments require them. Due to the growth of our system and the significance of the provided information, meanwhile, there are quite a lot of reports our plant requires.

M-QIS helps.

This is another product that should be installed as a server. It offers several functions and the first one I will use is the Reporting System.

I define reports that I have created with the Form Designer. Then I allocate them to selections in my database, i.e.

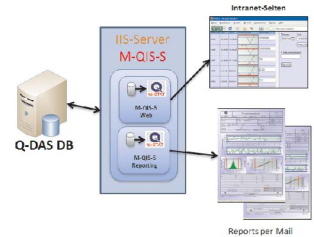


Figure 16: M-QIS server

a certain amount of data, no matter if they are related to parts, characteristics or values. I am able to provide “groups of recipients” with a certain report and data. These recipients are e-mail groups, printers and PDF storage folders.

The combination of report, data and “recipient” can be created as a job in M-QIS so that this job will be done automatically at regular adjustable intervals.

Would you like some examples?

Every morning my shift supervisors receive an e-mail including a PDF file about the evaluation of the previous day. In addition, the head of our division gets a monthly evaluation of the production. The QM department also receives reports, but only about bad characteristics - a separate report for each customer we support. Automatically, etc.

“M-QIS is a powerful tool. Its included reporting function automates your reporting system and indicates corporate information paths.”

Our Group Wants to See Some Information. I Control It!

Web-based intranet solutions ->M-QIS Web

M-QIS was actually installed because of the automated reporting system only. But I am curious and there is a webserver activated on the server M-QIS is installed on. Born as a small test system, it developed into a source of information for colleagues working in other plants.

The principle is quite simple. Q-DAS® provides a kind of qs-STAT® web version. It can be completely adapted to your needs. Anyone who is acquainted with web applications, is able to integrate it into the own intranet structure quickly. Now a Q-DAS® website is part of our intranet.

We actually use almost every qs-STAT® function. Read from database.



Figure 17: M-QIS web

Display of measured data. Open reports etc. However, everything is globally accessible. Of course, only within our group. Now the other plants have got the option to see current data, however, only those data we release. By using VPN tunneling I can also access these data at home.



Figure 18: M-QIS web

And how can we top this?

Since lately, even suppliers are connected to our network. They have their own website in our Q-DAS® intranet and just need a mouse click in order to load their measured data into their own supplier database from the distance.

That is how we check the quality of the supplied parts, even though these parts have not even arrived at the plant yet.

In the course of time, we reduce the burden of the people working in the goods receipt department. To some extent, the supplier now conducts the incoming goods inspection.

“The M-QIS web application may be integrated into corporate intranet systems. You can use quite a lot of qs-STAT functions there. Reports are generated dynamically.”

Even More Data. Do I Really Need Them All?

Data compression & outsourcing -> M-QIS Reporting

In order to describe M-QIS comprehensively: There is also the option to compress and outsource data. First, some information about outsourcing.

Outsourcing helps to export certain datasets as files automatically at specified intervals. These datasets have to meet certain regulations. After the export is completed, the files are saved to an archive database or on any storage medium, as required. We do not need that yet. But there will be the day when our databases exceed a certain storage capacity or contain a multitude of parts so that we would like to use this function. We will separate our data. Then we will have a fast production database containing “few” data and a big archive database.

Data compression is another topic. I have got the option to save describing statistics instead of measured values or in addition to these values. How do I apply it?

We assume that I collect one million measured values each month for years. Actually, we do not need every measured value that we recorded five years ago in our plant anymore. However, we require the capability index, average, standard deviation, etc. calculated for each single calendar week.

This is what data compression does. These statistics are calculated and saved to the 10000 measured values of week 14 automatically. Maybe they are even separated

by machine and batch. So, in the end, our 10000 pieces of information become about 20 in our example. The data are compressed. And in our case, this is sufficient for the data recorded five years ago. The database is compressed and I gain some storage capacity. And we save the raw values on storage media.

“M-QIS data compression and outsourcing helps to control the amount of data. The compression and outsourcing is automated according to your own regulations.”

Other Plants Also Want the System – But the Same One, Please.

Evaluation methods -> all products

Just a few more comments on the heart of the Q-DAS® software which are the evaluation methods or the functionalities of the programs.

Other plants of our group went along with us. However, it was important to meet the requirement that the calculation of statistics is the same for all plants.

Q-DAS® software makes it possible by providing “evaluation methods”. They consist of a collection of calculation rules, inspections / tests and requirements.

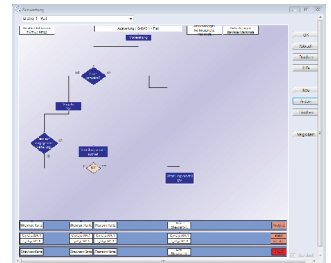


Figure 19: Evaluation methods

A huge number of group and corporate strategies exist. In most cases, the companies use the methods of their customers, if available.

The evaluation methods are another reason why you do not have to select the suitable distribution model or calculation method for the data yourself when working with Q-DAS® products. The program always determines them automatically and correctly. Our former Excel data recording was only able to calculate normal distributions, since Excel just offers functions for working with normal distributions. However, the normal distribution rarely occurs. Q-DAS® programs analyze the data and select the best suitable distribution model in order to make a statement about the population. It does not matter whether it is a Weibull, mixed, logarithmic normal or any other distribution, Q-DAS® products get it right.

Supported by TEQ® (Q-DAS® Group) we defined an own customized evaluation method. This is our standard now that can be imported and exported. We all use the same calculation methods, company-wide.

Moreover, you may not only exchange strategies but also any other settings (graphics, catalogs, etc.) between different installations.

“The evaluation methods help you to evaluate all the data in the same way, company-wide. It is easy to select specific customer requirements or guidelines.”

Camera Works.

The CAMERA Concept -> all products

Collecting, Assessing, Managing, Evaluating, Reporting, Archiving. These are the single steps of the performance measuring system designed by the Q-DAS® company. We implemented this system by using all the components already described.

We monitor our production. We know our products. We have an alarm system informing us about critical characteristics by e-mail. Our reports are distributed automatically. The customer receives less defective parts. We do not need any special trips to solve problems anymore. No loss of image. We optimize our products directly at the machines. Ideal runtimes for tools. Exact monitoring of cavities, batches and machines while producing parts. Improvement, optimization and finally: quality.

A quote for a change: "The Q-DAS® CAMERA Concept serves the purpose of efficiently introducing and designing a performance measurement system for quality assessment in industrial production."

My Conclusion:

Wait! I really should stop here. Please keep in mind that this is just an experience report that I have made up.

The author of this article, me, does not work in quality assurance but is an employee in the system integration department of Q-DAS®. Thus he is definitely partisan, too. The employees of this department offer international workshops, support and installations for new and existing customers.

However, he did not invent all the experiences he describes in this report. Only the combination, i.e. the company and the product, does not agree with reality.

This report consists of a wide range of experiences the author gained while completing his last installations. Maybe interested people and even long-time customers will gather thoughts about new methods and solutions after reading this article.

Of course, not every company requires all these components. Some of them will not be as reasonable as described here. And sometimes it is not even advisable to introduce all required components immediately.

A system has to grow. Users shall accept it. And it should be flexible and provide a lot of different options.

Maybe, with this in mind, we will meet soon...?

Software Validation

Why Validate Software?

People generally assume that software systems always provide correct results. However, these programs are highly complex and complexity causes errors. You can never exclude errors having a dramatic impact on the results.

It is not possible to imagine companies that do not apply software today. Nowadays, software is kind of the "central nervous system" of a company. Thus the correctness of such systems is of utmost importance, especially in case of calculated quality indices major corporate decision processes are based on. People became more and more aware of this problem and paid more attention to software validation. Software validation is even obligatory for officially regulated companies (pharmaceutical and medical engineering).

What is Software Validation?

If you want to put it simply: By validating an installed software system you want to furnish proof that the system delivers the performance it is supposed to deliver.

Dr.-Ing. Edgar Dietrich, Stefan Weber, GmbH® & Co. KG
Dr. Berthold Lebert, Independent Consultant

In accordance with ISO 9000:2005, validation is the "confirmation through the provision of objective evidence that the requirements for a specific intended use or application have been fulfilled". You may provide this evidence based on conformity assessments by observation or evaluation and, in case of conformance, validate the software by means of measurements, tests and comparisons.

