IBS
Precision Engineering

Understanding the true
meaning of **precision**

Rotary Inspector

5-axis machine
tool metrology

Intelligence made simple


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TRINITY

Contents

The advantages of five-axis machining are significant. Along with the ability to machine complex parts it can save time, money and reduce risks on set up and fixturing. Monitoring and control of the accuracy of your 5-axis machine is critical to deliver such performance benefits. The Rotary Inspector is designed to determine (and correct) critical performance parameters. Measuring according to ISO 10791-6, it provides a simple approach to ensuring the geometric and dynamic performance of the machine.

Key Features

- 5-axis dynamic measurement (ISO 10791-6)
- Measurement time < 1min
- Q-value: Geometrical error
- P-value: Surface and form error
- Standard quality report
- Status & trend data: machine, group, cell or factory level
- Compensation option

5-Axis machine accuracy

With the Rotary Inspector, IBS has pioneered technology for the kinematic quality assessment of 5-axis machine tools which addresses the limitations of current techniques.

Based on standard ISO measurements it delivers fully automated measurement in under a minute to derive the total 5-axis machine tool accuracy. It also calculates the pivot line offsets and squareness errors. A standard quality report is produced for each machine measurement simplifying in-house quality management of machines as well as providing an auditable document of the machine status.

A factory wide solution

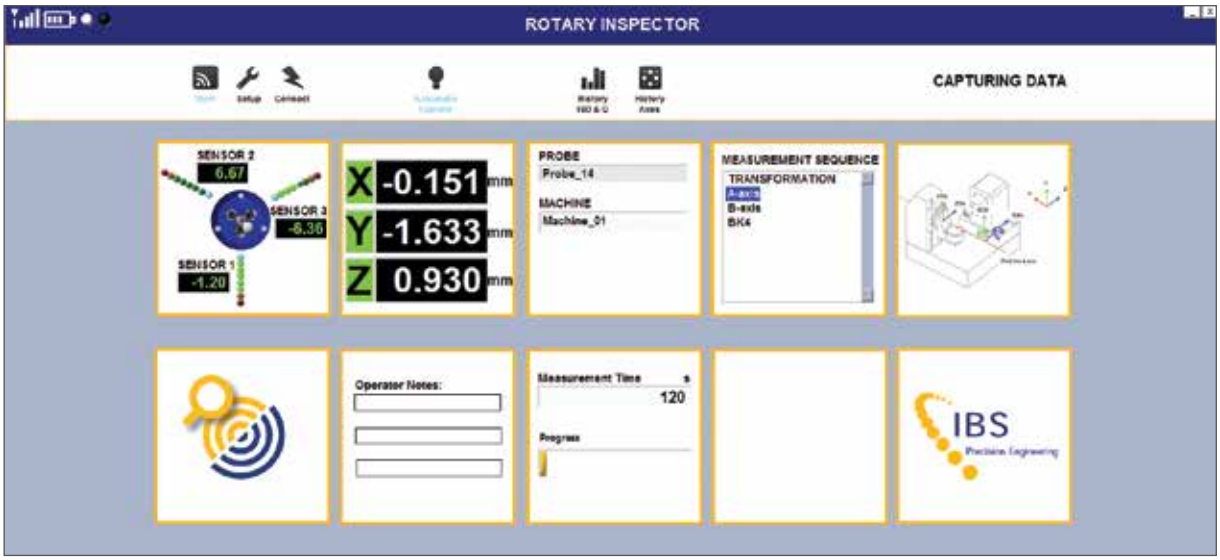
To simplify the management of large numbers of machines, two quality figures are derived from the machine measurement.

The **Q value** is the maximum geometrical error. It provides a boundary for the product dimensional accuracy that may be achieved under 5-axis machining.

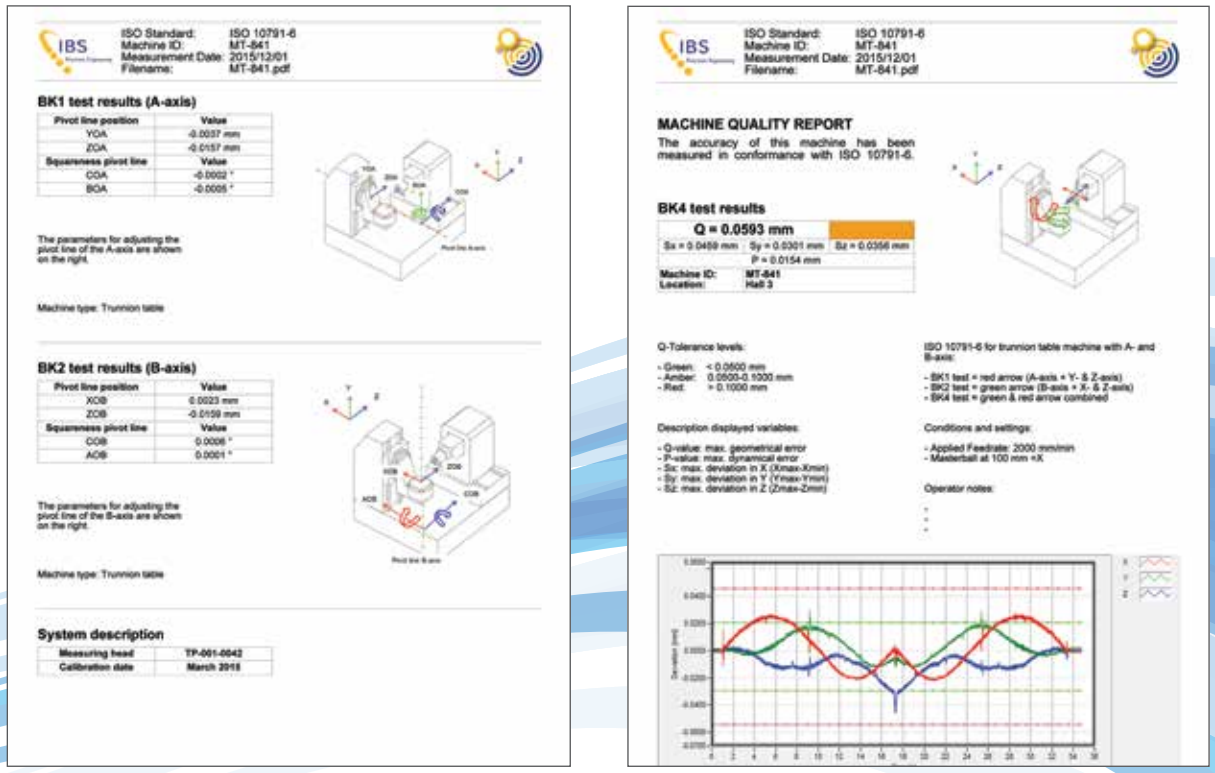
The **P value** is a measure of the largest dynamic error of the machine, resulting from issues such as backlash or worn bearings. These errors will be seen in the surface finish of the machined product.

Simple but intelligent measurement software

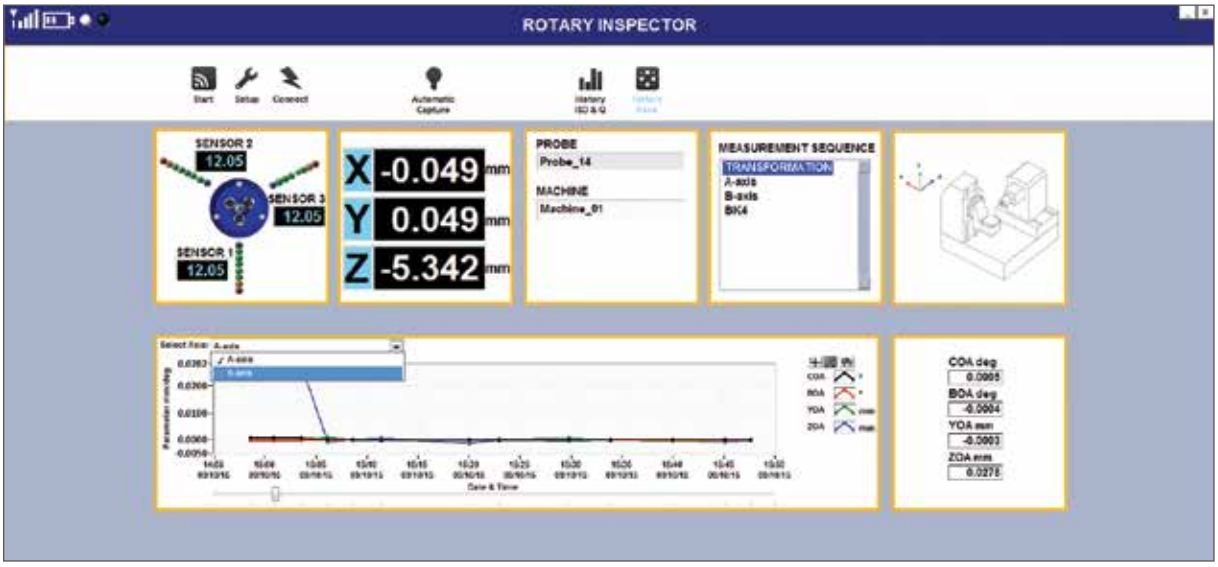
The Rotary Inspector measurement software is designed for operator use in a machine environment. It provides a fully automated measurement sequence with standardised protocols based on ISO10791-6. Machine results may be viewed instantly on-line or in a standard report.



Standard ISO 10791-6 measurement protocols.



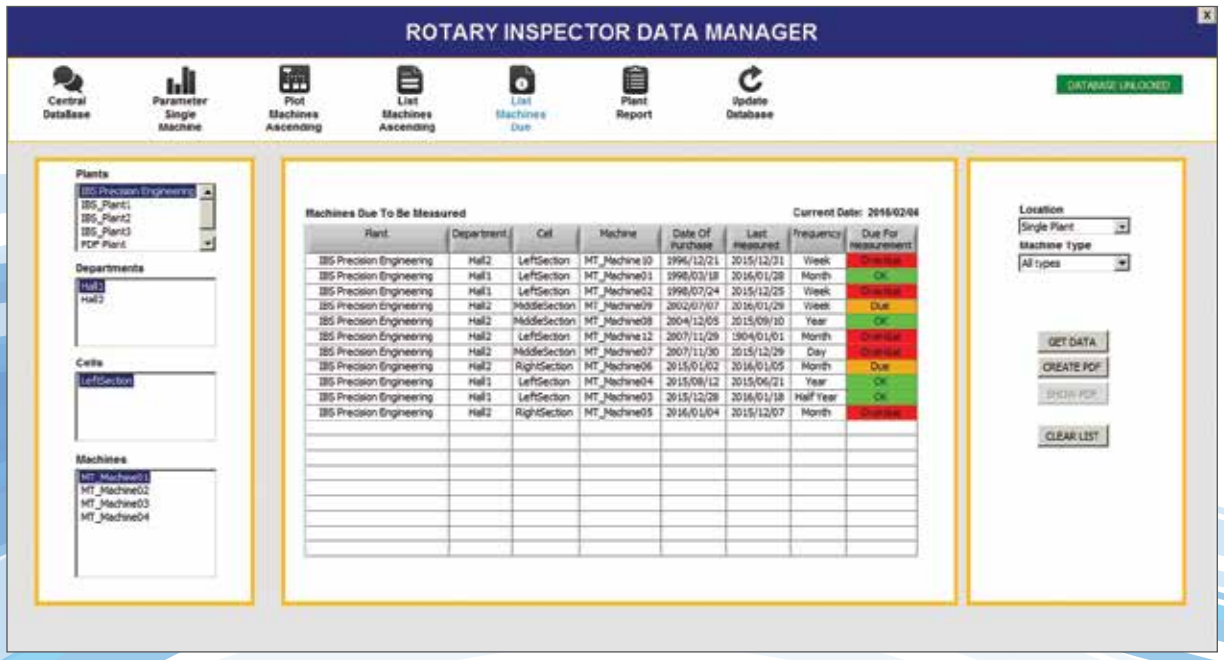
Standard quality report generated for each machine assessment



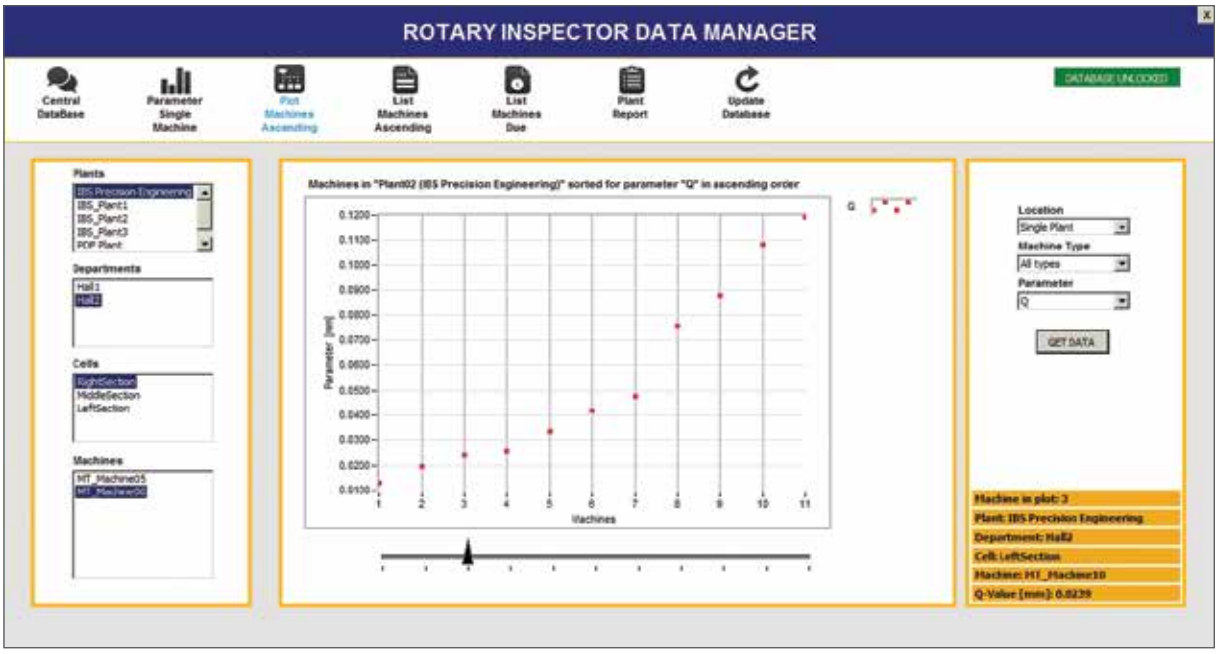
Machine data available on-line. Example: History of A-axis pivot point and squareness errors.

Management Oversight

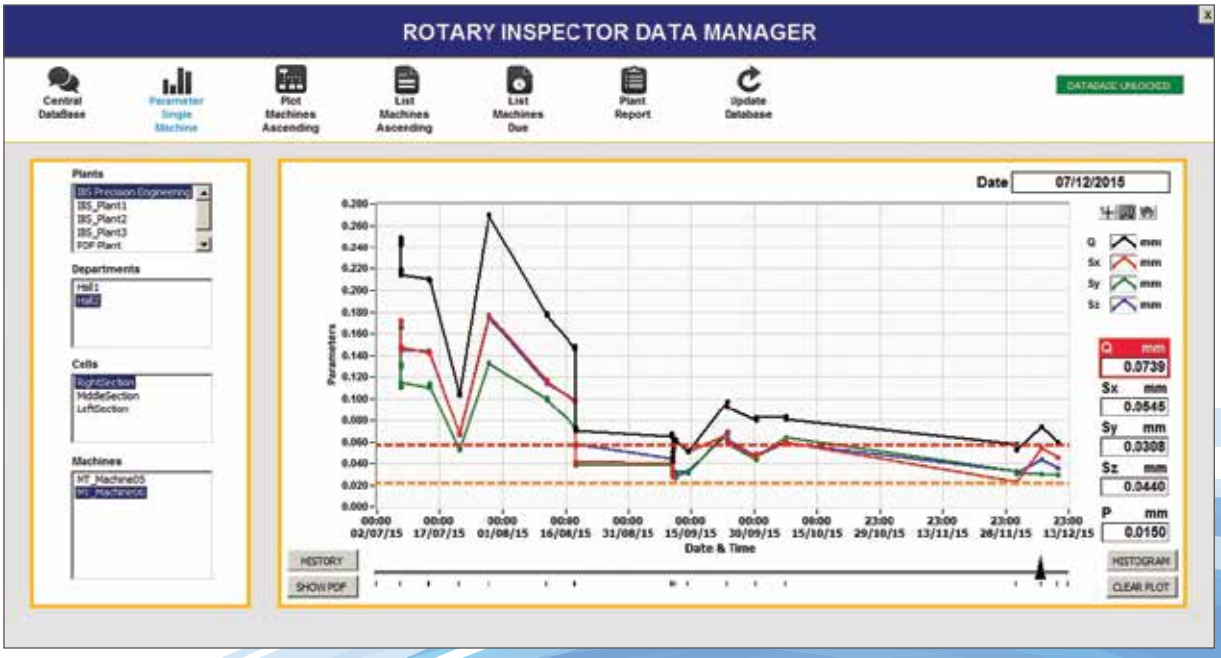
The optional **Rotary Inspector Data Manager** module (see p11) provides an overview of the history and current status of all machines integrated into the Rotary Inspector quality procedure. Machines can be monitored at a group, cell or factory level. This provides instant feedback on the status of the installed 5-axis machine base – for improved scheduling, reduced errors and customer compliance.



Measurement scheduling is automatically tracked.



Real time oversight of the performance of the installed machine base.



History and current status available on an individual machine basis.

Compensation

With the geometrical and dynamic error data captured, an optional machine compensation module is available. Figure 1 shows automatic compensation of a 5-axis machine with a Heidenhain 640 controller. In this example, the Q value was reduced from 129µm to 16µm in minutes. Also shown are the underlying maximum individual axis errors (Sx, Sy and Sz).

Green Data

As an Industry 4.0 solution the Rotary Inspector supports smart decisions enabled by the right data. At IBS we have created what we call a Green Data approach to our solutions. This means providing the critical results needed and no more. With the ability to measure more and more, comes the responsibility to avoid data pollution. In the Rotary Inspector data is transformed to the relevant parameters and this alone is stored.

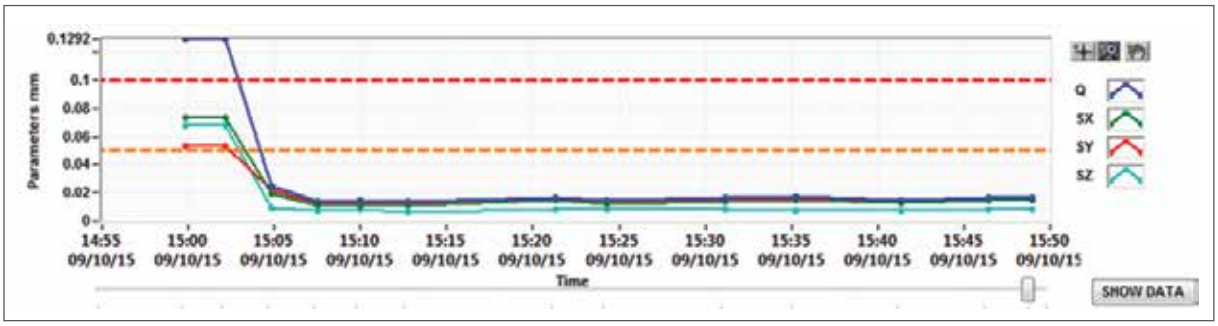


Figure 1. 5-axis machine geometrical error compensation. Calculated Q-value is shown as well as underlying maximum individual axis errors (Sx, Sy and Sz).

The Rotary Inspector Difference

As the complexity and precision of machine tools has increased, traditional methods of measuring their performance are failing. The Rotary Inspector addresses the four limitations of current techniques.

Automation	Dynamic Measurement	Speed	Continuous Monitoring
Automated protocols & unmanned operation supported	The Rotary Inspector measures real dynamic performance	Measurement times under 1 minute support regular quality assessment	Data logging of all machines shows current status and history

Hardware

The Rotary Inspector includes a Trinity wireless measuring head and masterball. Masterball placement can be permanent or pallet based. Optional EROWA mounts are available for accurate master ball positioning.

System hardware components:

- Calibrated Trinity measuring head
- Wireless access point & USB receiver
- Tool setter
- 22mm diameter masterball
- Mounting accessories (Erowa option)
- Travel case
- 4 batteries (3400 mAh) including charger

Trinity measuring head

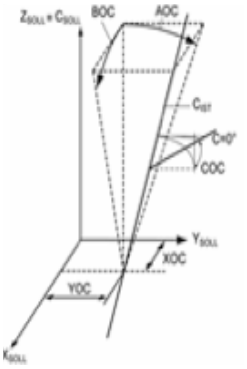
EROWA mounted master ball

Measuring head			
Measuring range	3,50 mm		
Resolution	0,2 µm		
Sampling rate	2 kHz		
Measuring uncertainty	U1 < 1,0 µm (within 1 mm range)		
Power consumption	> 24 hrs mixed operation		
	1,3 W (=17 hrs) when measuring		
	0,52 W (=42 hrs) when in sleep mode		
Wireless details PSK	2,4 GHz frequency, 802.11b/g/n standard, WPA2 - security		
Measuring head mounting shaft	∅ = 16 mm		
Dimensions	Length: 135 mm	Diameter: 80 mm	Weight: 770 grams
Masterball			
Roundness error	< 0,6 µm		
Diameter (nominal)	22 mm		
Length	75 mm		

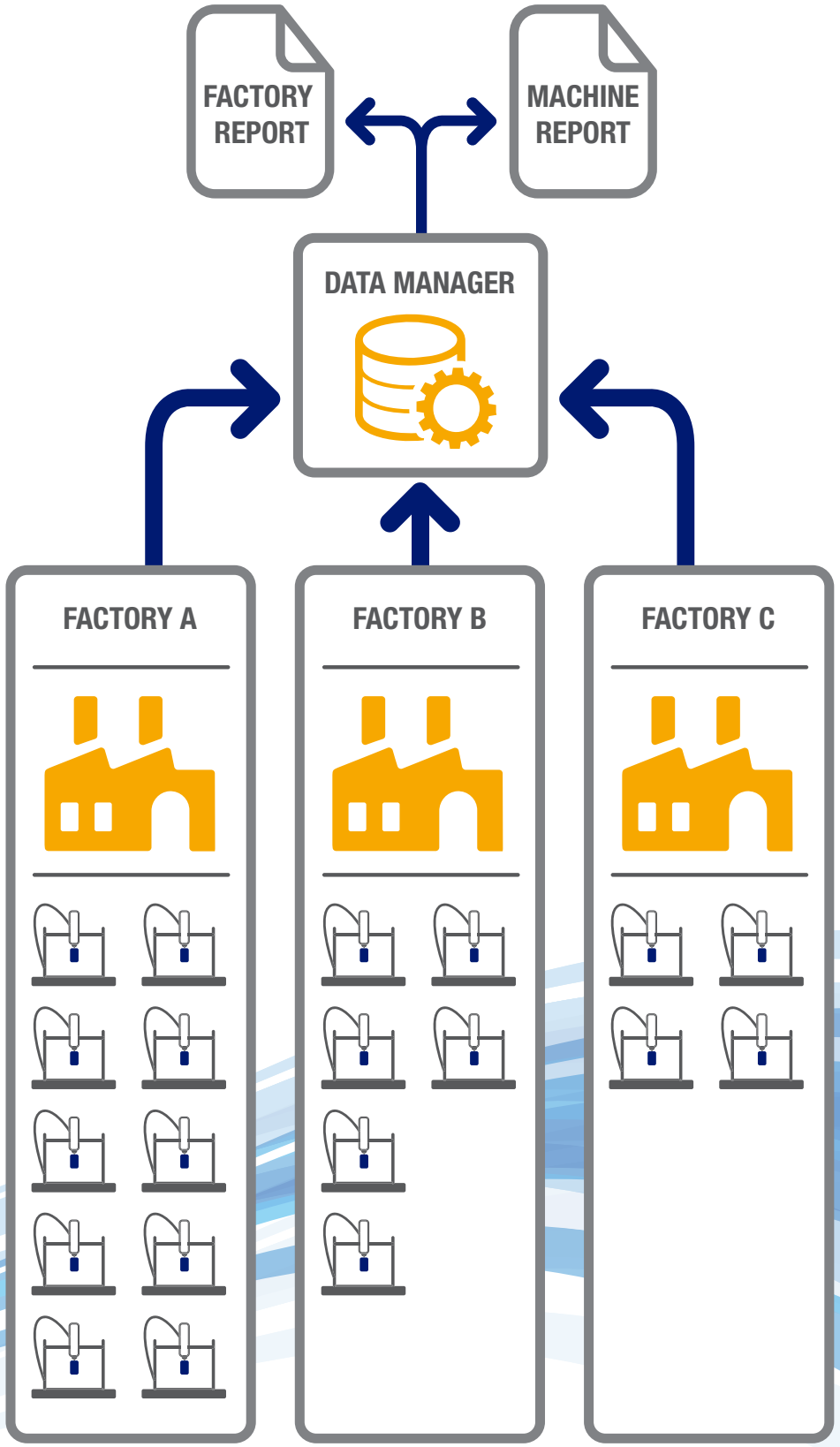
Key measurement parameters

Data Level	Parameter	Definition	Notes
1	Q-value	Max. geometrical error	Machine quality figures used for high level tracking.
	P-value	Max. dynamic error	

Data Level	Parameter	Definition	Notes
2	Sx, Sy, Sz	Max. error in X, Y or Z during 5-axis test	ISO 10791-6 parameters

Data Level	Parameter	Definition	Notes
3	**A-axis**		2 machine axes measured defined by machine type Parameters available for maintenance. Also applied in optional compensation module. 
	YOA	Y offset A axis	
	ZOA	Z offset A axis	
	BOA	Squareness around Y	
	COA	Squareness around Z	
	B-axis		
	XOB	X offset B axis	
	ZOB	Z offset B axis	
	AOB	Squareness around X	
	COB	Squareness around Z	
	C-axis		
	XOC	X offset C axis	
	YOC	Y offset C axis	
	AOC	Squareness around X	
	BOC	Squareness around Y	

Industry 4.0 Rotary Inspector Data Manager



IBS Precision Engineering

IBS Precision Engineering BV (Head Office)

Esp 201
5633 AD Eindhoven, The Netherlands
Telephone: +31 40 290 1270
Fax: +31 40 290 1279
E-mail: info@ibspe.com
www.ibspe.com

IBS Precision Engineering Deutschland GmbH

Leitzstraße 45
70469 Stuttgart, Germany
Telephone: +49 711 490 66 230
Fax: +49 711 490 66 232
E-mail: info@ibspe.de
www.ibspe.de

IBS Precision Engineering sarl

Le Magellan, 7 rue Montespan
91024 Evry Cedex, France
Telephone: +33 1 69 47 60 53
Fax: +33 1 69 47 60 70
E-mail: info@ibspe.fr
www.ibspe.fr

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