

# **Pressure Transmitter Worldwide Outlook**

MARKET ANALYSIS AND FORECAST  
THROUGH 2011

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#### Research Areas of Expertise

Allen's focus areas include Field Systems (Flow, Level, Pressure, and Temperature) and Wireless Networks.

#### Responsibilities and Experience

Prior to joining ARC, Allen was at Blackstone Research Associates, where he worked on several primary research projects that examined office technology issues. Research topics included color office printer adoption dynamics, the use of digital color production printers at Fortune 1000 corporations, and purchase dynamics for office multi-function printers and copiers. In addition to research, Allen also co-edited and wrote for Blackstone's monthly technology newsletter, the *Color Business Report*.

#### Education

Allen graduated from the full-time MBA program at the University of Rhode Island. He also has a BA in studio art.

#### ARC Research Reports and Publications

- Supply Side Continues Double-Digit Climb in the First Quarter of 2007
- Supply Side Shows Record Growth for Automation at Year End 2006
- Emerging Field Device Innovations and Communication Protocol Trends
- Automation Suppliers Charge Ahead with Double-Digit Growth in Second Quarter
- Ultrasonic Flowmeters Prove Themselves

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Paula's focus areas include Field Devices (Flow, Level, and Pressure), Process Analytical Chemistry, Intelligent Pumping Systems, and Laboratory Information Management Systems.

#### Responsibilities and Experience

Paula has over 30 years experience in the areas of sales and product marketing in industrial field instruments that utilize a vast array of technologies including magnetic, Coriolis, radar, electrochemistry, capacitance, and ultrasonic.

Before joining ARC, Paula spent 14 years at The Foxboro Company, in various capacities including two years in the Delaware field sales office in both inside and outside sales roles. She also spent seven years with Kentrol, Inc., a manufacturer's representative company, as an inside sales rep. where she was primarily responsible for sizing and selection of field devices including control valves and flow meters. At Kentrol she was also a member of the Quality Improvement Team. Prior to joining ARC, Paula was level product manager at Krohne America, Inc. for four years where her responsibilities included product technical support and directing US sales and marketing activities for all level products.

#### Education

Paula is a graduate of Northeastern University with a Bachelor of Science degree.

#### ARC Research Reports and Publications

- Biofuels and Thermo Fisher Scientific Come Out at PITTCON 2007
- NeSSI Generation II Is Ready for Prime Time
- Easing the Angst of LIMS Migration Projects
- Proper Control Valve Sizing and Selection Impacts Plant Performance
- Is Laboratory Informatics Ready for Prime Time?



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Wil's focus areas include Process Measurement Technologies, Plant Asset Management, Field Systems (Flow, Level Pressure, and Temperature), Wireless Field Devices, Field Device Communication Protocols, Inventory, Tank Management, Blending Systems, and Laboratory Information Management Systems.

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Wil has nearly 30 years experience in the areas of sales management, product marketing, and engineering experience in industrial field instruments that utilize a vast array of technologies including magnetic, coriolis, radar, capacitance, vortex, vibration, DP and ultrasonic.

Before joining ARC, Wil spent 10 years at Krohne Inc., where he held the position of Vice President of Sales. Wil was responsible for the sales of flow and level instrumentation in North America as well as developing business alliances with suppliers and users. At Krohne, he also held positions where he provided strategic product planning and technical support for Magnetic, Coriolis, Variable Area, and Ultrasonic Flowmeters. Prior to that, Wil spent 10 years at The Foxboro Company where he held positions of Senior Product Specialist and Development Engineer. Wil also held engineering positions at BIF, a Unit of General Signal, and Stone & Webster Engineering.

#### Education

Wil holds an AS in Mechanical Power Engineering from Wentworth Institute, a BS in Mechanical Engineering from Northeastern University, and an MBA from Bryant College.

- Process Automation Is Critical to Emerging Clean Coal Technologies
- China's New Manufacturing Challenge - The Transformation from Big to Strong
- Suppliers Shed New Light on Process Infrared Spectroscopy
- Radar Level Gauge Outlook
- Continuous Ultrasonic Level Measurement Device Outlook
- Magnetic Flowmeter Outlook
- Coriolis Flowmeter Outlook
- Ultrasonic Flowmeter Outlook
- Intelligent Pump Outlook
- Laboratory Information Management Systems Outlook
- Process Electrochemistry Systems Outlook
- Process Infrared Systems Outlook
- Outlook for Fieldbus Solutions in the Process Industries

#### Other Published Work

- *Making Coal the Other Clean Gas, Hydrocarbon Processing*
- *Improve Pump Performance and Cut Energy Costs, Hydrocarbon Processing*
- *Pumps Key to Performance, Energy Savings, Automation World*
- *TDR Level Measurement, Measurements & Control*
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- Field Device Technology Collaboration the Hallmark of Interkama 2007
- Adopting Diagnostic-Rich Certified SIS Devices Increases Safety and Reduces TCO
- Field Systems Strategies
- Pressure Transmitter Worldwide Outlook
- Plant Asset Management & Condition Monitoring Worldwide Outlook
- Ultrasonic Flowmeter Worldwide Outlook
- Coriolis Flowmeter Worldwide Outlook
- Magnetic Flowmeter Worldwide Outlook
- Temperature Transmitter Worldwide Outlook
- Trends in Process Field Device Automation
- FDT Gaining the Attention of Users and Suppliers
- Preserving HART Field Device Investments Reduces Cost of PAS Migration
- Need for Business Knowledge Transforms the Role of Field Devices

### Other Published Work

- **Hydrocarbon Processing**, *Leverage LIMS Intelligence to Improve OpX*
- **Petro Industry News**, *The Changing Personality of Flowmeters*

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## Chapter 1 Executive Overview

The pressure transmitter market, buoyed by a booming automation market rose at above average rates to \$1.8 billion in revenues, a CAGR of over 10 percent since 2004. Revenue increases were largely driven by massive capital expenditures in the Oil & Gas industry to increase its exploration and production capacity to meet rising global energy demand. Pressure transmitter suppliers have benefited from such investment and expansion activities, and they have aligned their business goals to capitalize on growing industry segments and geographic regions that will enable them to increase market share. Regionally, revenue breakdowns reflected the oil

and gas boom, with substantial increases in the Middle East. New plant construction in Asia continued to drive revenues. In North America, the 2005 hurricanes Katrina and Rita wreaked havoc on the U.S. refining and chemical plant infrastructure in the Gulf of Mexico, helping to drive automation shipments in 2006, as oil companies scrambled to get refineries back on line to satisfy ever increasing demand for gasoline. Repairs are still underway, and should continue through 2007.

With advance features such as diagnostic functionality and plant asset management, users are applying smart pressure transmitters more extensively in the plants. Recent technology innovations, particularly wireless, will contribute significantly to growth.

Leaders of the worldwide pressure transmitter market, leveraging ongoing technological developments such as the availability of more powerful microprocessors, reliable electronics, and embedded technology, continue to offer customers transmitters that are increasingly accurate, reliable, and functionally rich. With a variety of suppliers from which to choose, and advanced features such as plant asset management that give users a window into the health of their equipment and processes, users are applying pressure transmitters more extensively in their plants. The market leaders are all full line pressure transmitter suppliers who continue to bring innovative developments to the marketplace.

### Scope

This study is intended to serve as an effective planning guide for current suppliers and new entrants to the worldwide pressure transmitter market. By providing strategic market information for internal use, ARC studies

aim to help suppliers develop business plans for marketing and product development.

ARC's assessment of the worldwide pressure transmitter market includes market size and forecast, as well as a number of device specific segmentations such as transmitter type, intelligence, application, and communication protocol. The report also contains analysis of the industry structure, customer classification, distribution channel, supplier market shares, and profiles. In addition to the quantitative assessment of the pressure transmitter marketplace, this report provides an insightful analysis of the products and strategies of the leading pressure transmitter suppliers. This study is intended to assist suppliers and purchasers in staying abreast of pressure transmitter technology advancements, and explores in-depth the key issues that will impact this business in the near future. These issues include:

- Short and long-term potential for the pressure transmitter business
- Impact of new technologies on the pressure transmitter market
- Outlook for pressure transmitters by industry
- Impact of competing technologies on the pressure transmitter market
- Key elements for success in the pressure transmitter business

This report contains analysis of pressure transmitters as used in the process and batch industries. There are a number of industries in which pressure transmitters are utilized, including Oil & Gas Production and Pipelines; Chemical, including Petrochemical, Fine Chemical, and Plastics & Rubber; Food & Beverage; Pharmaceutical; Pulp & Paper; Mining & Metal; Electric Power; and Waste & Wastewater. Applications for pressure transmitters range from basic gauge pressure measurement, flow and level measurement, and custody transfer.

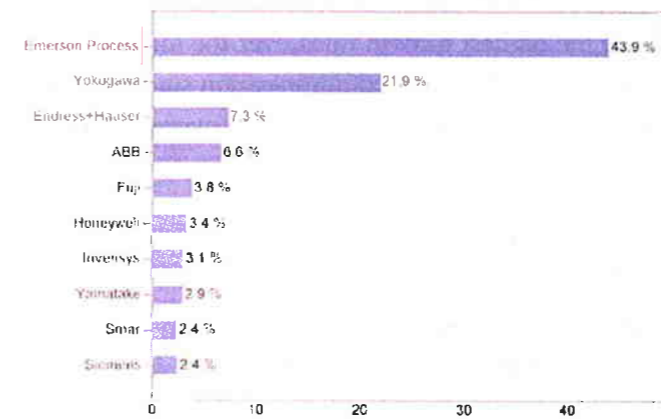
**Market Size and Forecast**

While the automation and field instrumentation suppliers have seen extraordinary revenue increases in recent year, there are signs that this period of breakneck growth has passed, and growth will moderate somewhat in the coming years. The worldwide pressure transmitter market, which grew at double digit rates to reach \$1.8 billion in 2006, is expected to grow at a compound annual growth rate (CAGR) of 5.2 percent to approximately \$2.3 billion in 2011. Growth rates will remain somewhat higher than average

earlier in the forecast period, thanks to the continued emphasis on PAM and smart instrumentation, and an expected upswing in the adoption of wireless pressure transmitters. Over the longer term, however, year-on-year growth will taper to traditional levels.

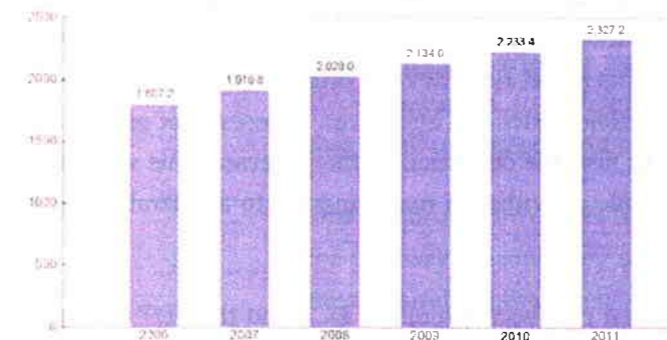
Regionally, suppliers can expect to see the largest growth in the Middle East, due to its high concentration of Oil & Gas activities, and in Asia,

where heavy investment in new plant construction continues in core sectors, such as Chemical & Petrochemical, Oil & Gas, Power, and Steel production. In the mature North American and Western European markets, suppliers will largely rely on replacement business. Latin America, home to several large scale oil and natural gas projects, will see above average growth, but still remain a relatively small market for pressure transmitter suppliers.



**Market Shares of Leading Pressure Transmitter Suppliers**

The Oil & Gas and Refining industries accounted for the majority of the overall growth of the pressure transmitter market over the past three years, and will continue to drive market growth going forward. Oil & Gas companies are enjoying record profits, thanks to sustained high prices for their products, giving them ample capital to increase their production and refining capacity to satisfy demand, which shows no sign of abating. The value of oil has caused Oil & Gas companies to work to improve monitoring processes to prevent product loss and optimize production, which requires deployment of intelligent field devices. Compliance with ever tightening



**Total Shipments of Pressure Transmitters, 2006 - 2011 (Millions of \$)**

safety and environmental regulations will also drive investment in pressure transmitters among Oil & Gas companies. Recent refinery explosions at BP's Texas City refinery and the UK's Buncefield oil storage facility highlight the need for better process measurements, which is helping drive increasing adoption of reliable SIL-rated transmitters for Safety Instrumented Systems to reduce risk of

catastrophic events.

Sales of smart pressure transmitters will outpace those of conventional and low cost devices, as users seek to improve their visibility into plant operations to maximize productivity and the availability of production resources. This asset management focus of users is also fueling demand for transmitters that incorporate powerful onboard diagnostics capabilities, and use digital communication protocols. Foundation Fieldbus and Profibus-enabled transmitters will see the highest growth rates over the forecast period. Despite this, HART remains the de facto communication standard for pressure transmitters, and will continue to account for the overwhelming majority of shipments.

### Strategies for Success

Although the worldwide pressure transmitter market is currently enjoying a phase of strong growth due largely to strong demand from oil & gas and refining companies, this growth phase will not last forever. Below are some key strategies for success for suppliers of pressure transmitters to remain competitive and position themselves for continued success.

#### Help Users to Fully Utilize Intelligent Field Devices

Although many intelligent field devices have been installed, they are underutilized, with smart functionality only being used when a device is commissioned locally, using a handheld communicator. Integrating HART field devices with DCS and PAM systems provides information to operations and maintenance without leaving their offices. Diagnostic and plant asset management functions inherent in smart field devices lie fallow, and users fail to realize potential operational and productivity benefits. Suppliers should offer training and education initiatives to help users to leverage device intelligence beyond the installation and configuration stage. To get users to visualize the benefits smart field devices offer, provide clear demonstrations of how device diagnostics can help users to assess not only the condition of the device but also the condition of the process. This will increase service revenues while providing a ready market to accelerate field device PAM solutions.

Also, the recently announced collaboration of the ECT and the FDT Group will work towards a universal field device integration (FDI) solution. When this receives IEC approval, it will remove one of the major obstacles in PAM implementation, which will drive increasing adoption of smart

transmitters. Users will be able to configure and manage FDI-enabled intelligent field devices via Windows PC workstations and handheld field communicators. The FDI solution will also give users access to advanced diagnostics and allow them to analyze process performance. While a compelling vision, development work will take some time, and a specification is not expected to be completed until late 2008. Suppliers should do what they can to support such interoperability and connectivity initiatives, with an eye toward helping users to better integrate and utilize intelligent field devices in their plant operations.

### Embrace Wireless Technology

Pressure transmitter suppliers should stay abreast of developments in wireless technology and how it can be deployed in process manufacturing environments. The desire for new and improved business processes extends across all types of manufacturing. A major factor favoring greater deployment of wireless technologies in manufacturing is the ability of wireless applications to enable new and better ways of operating manufacturing plants with little expense.

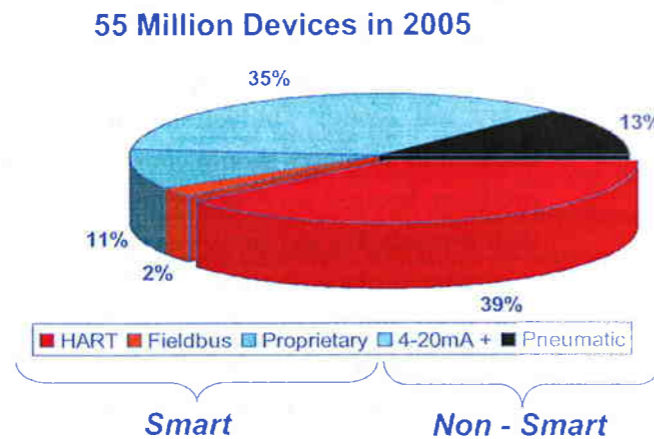
Wireless technologies allow users to more fully leverage the benefits of their intelligent field devices, giving them access to more live process and diagnostic information. Wireless is a cost effective means of connecting production assets, like flowmeters and valves, to asset management and control systems, and it opens up many possibilities for improved control and optimized production by adding more measurements that were previously too costly. Industrial wireless is here to stay, and pressure transmitter suppliers should consider adding wireless connectivity to their products, because wireless not only allows users to connect field devices to their systems, but also serves as a justification for them to replace their older pressure units with smart, wireless devices. Suppliers should collaborate with users and wireless standards bodies, such as SP100 and the Wireless HART initiative, to develop standards-based wireless pressure transmitters that fulfill user needs and expectations.

One major concern users have about wireless field instruments, and one of the primary reasons they are hesitant to install them in their plants, is that the transmitters often rely on loop or battery power. While pressure transmitters come with lifetime warranties, and can go for long stretches without calibration (as long as 15 years, in some cases), batteries by and large have a relatively short lifespan. Suppliers should work to improve the designs of

their transmitters to reduce power consumption to increase battery life and operating cycles. Ideally, the battery should last until a pressure transmitter is scheduled for calibration.

**Develop a Practical Replacement Strategy**

While pursuing new project activity in growing industries is a sound growth strategy, suppliers should augment this focus with a practical replacement strategy for the aging installed base of conventional pressure transmitters, which presents a huge opportunity to grow revenues in mature markets. Indeed, ARC estimates that out of the 55 million field devices installed (as of 2005), 48 percent need to be upgraded to allow users to integrate their field devices with PAM applications. Often, when their existing pressure instruments fail, users expect exact replacements, right down to the model number. While a direct swap out of a conventional transmitter that is familiar may help to streamline the installation process, users are missing out on the operational benefits that intelligent field devices can provide, such as improved reliability and accuracy, along with diagnostic capabilities. Suppliers should assist users in developing programs to replace their underperforming conventional transmitters with smart transmitters. This will contribute to the adoption of intelligent pressure transmitters, as users replace their conventional transmitters to take advantage of PAM applications.



**48% of the Installed Base Must be Upgraded**

**Leverage High Growth Global Regions**

Taking full advantage of the global regions that are experiencing the highest industrial and infrastructure growth, such as China, India, the Middle

East and Eastern Europe, suppliers should invest in improving their distribution channels, including production facilities, sales, service and repair locations in these areas. Less developed regions, such as India, are likely to have less demanding applications, and as result may not need cutting edge field device technology. This can provide new markets for conventional and low cost pressure transmitters, breathing new life into these older-generations products, which have been declining as sales of intelligent transmitters grow.

**Include a Larger Service Component in Product Mix**

Another way for suppliers to grow their business is to transition from a predominantly product oriented focus to include a larger service component in their offerings. Manufacturers are losing internal engineering, operations, and maintenance expertise as baby boomer retire, and fewer new engineers and technicians step up to take their place. They look to suppliers to play a key role in filling this staffing and skills gap. In response, automation suppliers have broadened the scope of services they offer, from front-end engineering and design to operations, outsourced maintenance, and performance improvement. Both users and suppliers benefit from a more collaborative relationship: users can leverage the expertise of suppliers to help them manage plant assets across their entire lifecycle; suppliers can go beyond being just hardware providers, and enhance their overall project revenues and enjoy long term revenue streams through the service relationships they build with their customers.

**Develop SIL-rated Transmitters**

After several high-profile accidents in recent years, safety has emerged as a huge issue, particularly in the Oil & Gas and Chemical industries. This has major implications for field device suppliers, who must provide intrinsically safe, reliable transmitters that support safety instrumented systems. To remain competitive and to be considered for large Oil & Gas projects, suppliers should work to get their pressure transmitters SIL-certified by Germany's TÜV. To satisfy the needs of the Oil & Gas industry, pressure transmitter suppliers' product lines should include SIL-2 and SIL-3 rated devices. To take advantage of expected growth in the Nuclear Power industry, which is on the cusp of something of a comeback after several disappointing decades, suppliers will need to offer SIL-4 rated devices. While product development and the certification process carry significant costs, suppliers will see a payoff, because SIL-rated products command a

price premium. Ensure that your devices are compatible with offerings from major SIS suppliers.

## Chapter 2

### Scope

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This study is intended to serve as an effective planning guide for current suppliers and new entrants to the worldwide pressure transmitter market. By providing strategic market information for internal use, ARC studies aim to help suppliers develop business plans for marketing and product development. The information contained in the study is “client confidential” and should not be used externally or republished without express written consent from ARC.

#### Key Issues Researched

ARC's assessment of the worldwide pressure transmitter market includes market size and forecast, as well as a number of device specific segmentations such as transmitter type, intelligence, application, and communication protocol. The report also contains analysis of the industry structure, customer classification, distribution channel, supplier market shares, and profiles. In addition to the quantitative assessment of the pressure transmitter marketplace, this report provides an insightful analysis of the products and strategies of the leading pressure transmitter suppliers. This study is intended to assist suppliers and purchasers in staying abreast of pressure transmitter technology advancements, and explores in-depth the key issues that will impact this business in the near future. These issues include:

- Short and long-term potential for the pressure transmitter business
- Impact of new technologies on the pressure transmitter market
- Outlook for pressure transmitters by industry
- Impact of competing technologies on the pressure transmitter market
- Key elements for success in the pressure transmitter business

This study is one of many field device market studies available from ARC, including reports on all other major instrumentation utilized in the process industry. Each study follows a similar structure as presented here and all market data is provided in US dollars.

**Market Size and Forecast Definitions**

ARC derives market size figures from its extensive in-house databases and in-depth interviews with leading suppliers. The market size, base year 2006, is defined in terms of shipments by industry participants, not by bookings or orders. Margins earned by distributors and other sales channels are excluded. Average Selling Price (ASP) reflects factory level pricing.

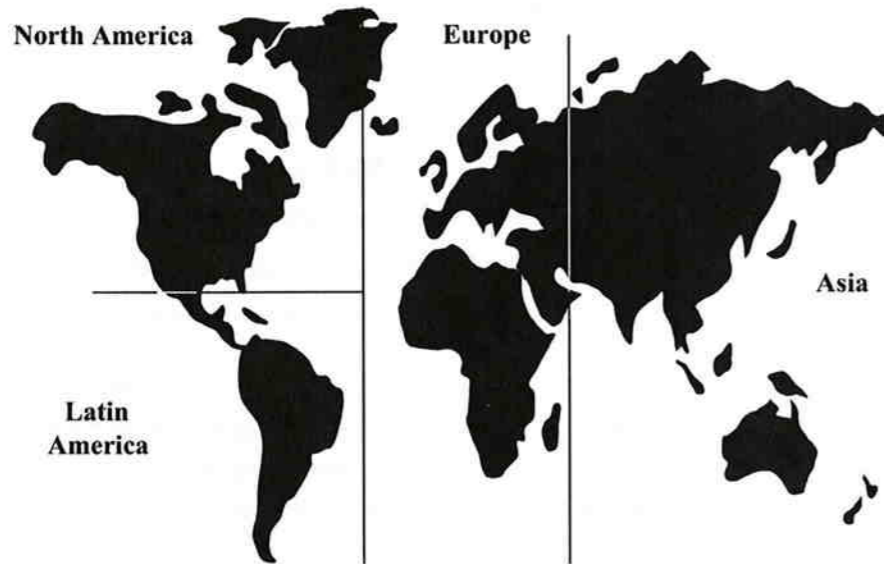
Market size information is derived from ARC's extensive in-house databases and in-depth interviews with the leading pressure transmitter suppliers.

A combination of factors, including user projections of future demand and ARC's assessment of the growth potential for each segment form the basis of ARC market size and forecasts estimates. Five year forecasts in this study show long-term trends. The outlook for any business, however, can dramatically change due to rapidly changing technology and global economic environment.

ARC recommends clients obtain the latest updates from ARC before making any important decisions.

**Key Regional Segments**

Geographically, ARC has divided the marketplace into four major segmentations: North America, Latin America, EMEA, and Asia. North America consists of the United States and Canada. Latin America is comprised of Central America, Mexico, and South America. EMEA consists of Western Europe, Eastern Europe, CIS, Africa, and the Middle East. Asia consists of Japan, China, India, Taiwan, South East Asia, Korea, and Australia.



**Geographic Segmentations**

**Key Currency Factors**

To eliminate changes in market size due to ongoing currency variations, ARC uses average exchange rates over a 12 month period running from October 1 to September 30 for the leading currencies. Each year, ARC updates the exchange rates used in our market analysis and forecasts to portray the most realistic picture of the market possible. When comparing ARC reports from different years, customers must take into account the ongoing changes in exchange rates that occur from year to year and use the exchange rates given in each study to convert back to local currencies. All ARC forecasts are prepared in current US dollars and are based on the assumption that the current inflation rate of approximately 3 percent will continue throughout the period covered by this report.

Country	National Currency (Abbreviation)	Exchange Rate National Currency units per US Dollar (\$)
European Union	Euro (€)	0.78
Japan	Yen (¥)	116

**Average Currency Exchange Rates Used In ARC Market Studies**

**Key Industry Segments**

Industrial markets are typically classified into process and discrete industries. This report contains analysis of pressure transmitters as used in the process and batch industries. There are a number of industries in which pressure transmitters are utilized, including Oil & Gas Production and Pipelines; Chemical, including Petrochemical, fine Chemical, and Plastics & Rubber; Food & Beverage; Pharmaceutical; Pulp & Paper; Mining & Metal; Electric Power; and Waste & Wastewater. Pressure transmitter applications range from basic gauge pressure measurement to custody transfer applications. Details of key process industry segment codes according to SIC, NAICS, and NACE are provided.

**Key Product Classifications and Market Segments**

ARC's assessment of the worldwide pressure transmitter market includes market size and forecast, as well as a number of device specific segmentations such as transmitter type, intelligence, application, and communication protocol. Below is a brief description of the key segments included in ARC Advisory Group's analysis of the worldwide Pressure Transmitter market.

### Pressure Transmitters by Intelligence

ARC' secondary segmentation of the pressure transmitter market continues to be by intelligence, which is increasingly becoming a two tiered market: smart pressure transmitters and the rapidly diminishing segment of conventional pressure transmitters. The criterion for distinguishing pressure transmitters by their intelligence includes remote communication capabilities, microprocessor-based electronics, control signal, and repair-ability.

The criterion for distinguishing pressure transmitters by their intelligence includes remote communication capabilities, microprocessor-based electronics, control signal, and repair-ability.

Smart pressure transmitters offer microprocessor-based electronics along with remote communications. Depending on the application, communication is accomplished either through a DCS and/or a handheld terminal. Remote communication enables remote recalibration and re-ranging, as well as diagnostics capabilities. Many smart pressure transmitters also offer installed performance accuracy of  $\pm 0.1$  percent or better under installed process conditions. High end smart pressure transmitters, such as Emerson Process Management's 3051S, offer accuracy  $\pm 0.025$  percent under reference conditions.

A conventional pressure transmitter contains the standard sensor/transducer/amplifier combination of a smart transmitter in a protective housing, but unlike smart transmitters, they do not contain microprocessor-based electronics. Conventional models typically provide an analog output signal, such as a 4-20mA current signal.

Low cost models often use less costly sensing elements and typically do not easily lend themselves to repair due to the hermetically sealed electronic compartment. They are usually lighter weight and of smaller size than conventional and smart models, and normally are of a fixed measurement range. Smart and conventional transmitters can be repaired by either replacing the sensor or the electronic module.

### Pressure Transmitters by Type

Differential pressure (DP) transmitters are primarily used in flow measurement and level measurement applications. DP transmitters are ideal for custody transfer applications due to their inherent accuracy when used in conjunction with a primary measurement device. Flanged versions are more popular in applications such as hydrostatic tank gauging, wedge meter flow, and in the Pharmaceutical and Food & Beverage industries when furnished with the requisite sanitary connection.

Gage pressure, most often referred to simply as pressure, is one of the most fundamental measurements used in process control. It is used in a wide variety of applications, ranging from measurement and control of fluids in pipelines to storage or agitated process vessels. Gage pressure is defined as the difference between the pressure inside a pressurized vessel and atmospheric pressure. Gage pressure transmitters measure pressure, such as barometric pressure.

ARC's pressure transmitter by type segmentation includes gage, differential pressure, absolute, and multivariable transmitters.

Absolute transmitters typically utilize closed cell sensors. These sensors are manufactured by hermetically sealing a vacuum reference chamber on one side of the integrated circuit sensing element, thus making the measured pressure relative to the vacuum reference. Absolute transmitters are frequently employed for vacuum measurement applications, such as distillation columns and hydrocrackers in the Chemical and Petrochemical industries.

The multivariable pressure transmitters available today can transmit multiple process variables from a single source, such as differential pressure, gage pressure, and process temperature in conjunction with an external RTD or thermocouple. Multivariable pressure transmitters can be suitable replacements for other more expensive technologies, such as Coriolis flowmeters in some applications.

### Pressure Transmitters by Communication Protocol

All smart pressure transmitters fitted with field embedded microprocessors use various communication protocols. Some protocols are supported by large supplier and end user consortiums while others are proprietary. The major communication protocols discussed in the scope of this study include HART, Foundation Fieldbus, Profibus, and various supplier proprietary protocols.

HART protocol, the defacto standard, was originally developed by Emerson and is now promoted through the independent HART Communication Foundation. With HART protocol, a serial digital signal is superimposed over the 4-20mA control signal to facilitate communication with the host system.

Foundation Fieldbus and Profibus are multi-layered digital communication protocols. Foundation Fieldbus appears to be the favorite in process automation, while Profibus is widely implemented in factory automation.

These protocols typically offer multi-drop capability as well as bi-directional communication.

Included in the proprietary category are digital protocols and non-digital protocols indigenous to individual suppliers. These protocols are generally based on industry standard techniques, such as Frequency Shift Key (FSK) similar to that of HART. The greater percentage of this category represents the proprietary digital protocols supplied by Honeywell, Invensys, and ABB. It should be noted that proprietary protocols are losing market share to industry standard protocols.

**Safety Integrity Level**

Pressure transmitters are an integral part of safety instrumented systems (SIS). Most leading pressure transmitter suppliers offer safety integrity level (SIL) rated transmitters. Statistics indicate the root cause of an SIS failure is related to field devices, not of the safety system. Consequently, a safety system should include the health of associated equipment, including pressure transmitters. ARC's primary segmentation of the SIS marketplace is by application SIL levels as specified by IEC 61508 and ANSI/ISA 84.01 standards. Demand Mode includes actions taken in response to process or other conditions (generally no more than once per year). Continuous Mode includes functions, which implement continuous control to maintain functional safety.

Safety Integrity Level (SIL)	Probability of Failure on Demand Mode Operation	Probability of Failure on Continuous Mode Operation	Hazard/Risk Level
1	$\geq 10^{-2}$ to $< 10^{-1}$	$\geq 10^{-6}$ to $< 10^{-5}$	Minor property and production protection
2	$\geq 10^{-3}$ to $< 10^{-2}$	$\geq 10^{-7}$ to $< 10^{-6}$	Major property, personnel, and production protection
3	$\geq 10^{-4}$ to $< 10^{-3}$	$\geq 10^{-8}$ to $< 10^{-7}$	Employee and community protection
4	$\geq 10^{-5}$ to $< 10^{-4}$	$\geq 10^{-9}$ to $< 10^{-8}$	Catastrophic community impact

**Figure 2-1**  
**Typical Questionnaire for Market Data Collection**

**Pressure Transmitters**

**Press**  
Tab for Entry

**Note: Millions of \$**

**Description**      % \$      \$

**Last vs. Current**

2005     

CAGR      #DIV/0!

2006     

Please estimate Next Year's % Growth

**World Regions**

North America	<input type="text"/>	0.0
Europe, Middle East, and Africa	<input type="text"/>	0.0
China	<input type="text"/>	0.0
Japan	<input type="text"/>	0.0
Rest of Asia	<input type="text"/>	0.0
Latin America	<input type="text"/>	0.0
Total	0.0%	0.0

**Revenue Type**

Hardware	<input type="text"/>	0.0
Software	<input type="text"/>	0.0
Services	<input type="text"/>	0.0
Total	0.0%	0.0

**Intelligence**

Smart	<input type="text"/>	0.0
Conventional	<input type="text"/>	0.0
Low-Cost	<input type="text"/>	0.0
Total	0.0%	0.0

**Industries**

Oil & Gas	<input type="text"/>	0.0
Refining	<input type="text"/>	0.0
Chemical	<input type="text"/>	0.0
Petrochemical	<input type="text"/>	0.0
Food & Beverage	<input type="text"/>	0.0
Pharmaceutical & Cosmetics	<input type="text"/>	0.0
Pulp & Paper	<input type="text"/>	0.0
Mining & Metals	<input type="text"/>	0.0
Electric Power	<input type="text"/>	0.0
Water & Wastewater	<input type="text"/>	0.0
Other	<input type="text"/>	0.0
Total	0.0%	0.0

**Sales Channels**

Direct Sales	<input type="text"/>	0.0
Independent Representatives/Distributors	<input type="text"/>	0.0
Systems Integrators/Value Added Resellers	<input type="text"/>	0.0
Internet	<input type="text"/>	0.0
Total	0.0%	0.0

**Customer Type**

End User	<input type="text"/>	0.0
Original Equipment Manufacturer	<input type="text"/>	0.0
Systems Integrators	<input type="text"/>	0.0
Total	0.0%	0.0

**Analyst Name: Allen Avery**  
e-mail: aavery@arcweb.com  
Telephone #: 781-471-1156

**Note: Thousands of Units**

**Description**      %Units      Units

**Units**

**Total Units for 2006**

**Unit - Intelligence**

Smart	<input type="text"/>	0.00
Conventional	<input type="text"/>	0.00
Low-Cost	<input type="text"/>	0.00
Total	0.0%	0.00

**Unit - Communication protocol**

HART	<input type="text"/>	0.00
Foundation Fieldbus	<input type="text"/>	0.00
Profibus PA	<input type="text"/>	0.00
Other	<input type="text"/>	0.00
Total	0.0%	0.00

**Unit - Transmission Method**

Wired	<input type="text"/>	0.00
Wireless	<input type="text"/>	0.00
Total	0.0%	0.00

**Unit - Safety Integrity Level**

SIL-1	<input type="text"/>	0.00
SIL-2	<input type="text"/>	0.00
SIL-3	<input type="text"/>	0.00
Total	0.0%	0.00

**Figure 2-1 (Continued)**  
**Typical Questionnaire for Market Data Collection**

<b>Technology</b>	
Differential Pressure	0.0
Absolute Pressure	0.0
Gauge Pressure	0.0
Multivariable	0.0
Total	0.0%
<b>Communication Protocol</b>	
HART	0.0
Foundation Fieldbus	0.0
Profibus PA	0.0
Other	0.0
Total	0.0%
<b>Transmission Method</b>	
Wired	0.0
Wireless	0.0
Total	0.0%
<b>Application</b>	
Flow	0.0
Level	0.0
Direct Pressure	0.0
Other Indication	0.0
Total	0.0%
<b>Safety Integrity Level</b>	
SIL-1	0.0
SIL-2	0.0
SIL-3	0.0
Total	0.0%

**Please Answer The Questions In The Space Below**

1. What are your company's KSF (Key success factors)?
2. What top three industries contributed to your business in the Pressure Transmitter market?
3. Who are your top competitors? Please provide your perception of their market position.
4. What are the emerging trends in the Pressure Transmitter replacement market versus new project markets?
5. What factors are driving the growth of the Pressure Transmitter market?
6. What factors are inhibiting the growth of the market?
7. What are the challenges facing the Pressure Transmitter market?
8. What are the technology, product or market trends that affect the Pressure Transmitter market?
9. How will the Pressure Transmitter selling price change in the next couple of years?
10. What are your company's strengths, challenges and opportunities?

**Figure 2-2**  
**Standard Industry Code Classifications - Process Industries**

Process Industries	SIC Code	NAICS Code	NACE Code
Cement & Glass	32	327	26.1-26.8
Chemical & Petrochemicals	28 (except 283 & 284)	325 (except 3254 and 3256)	24.1, 24.2, 24.3, 24.5, 24.6, 24.7
Electric Power (Generation, T&D)	491, 4931	2211	40.1
Food & Beverage	20, 21	311, 312	15.1-15.9, 16.0
Metals (Primary Production)	33	331	27.1-27.5, 37.1
Mining	10, 12, 14	212	10.1-10.3, 12, 13.1-13.2
Oil & Gas (Exploration, Production)	13	211, 213111, 213112	11.1, 11.2
Oil & Gas (Pipelines)	46, 492	486, 2212	40.2, 60.3
Oil & Gas (Refining)	29	324	23.1, 23.2
Pharmaceutical & Cosmetics	283, 284	3254, 3256	24.4, 24.5
Pulp & Paper	26	322	21.1, 21.2
Textiles	22	313, 314	17.1-17.7
Water & Wastewater	494, 495	2213	41, 90

**Figure 2-3**

**Standard Industry Code Classifications - Discrete Industries**

Discrete Industries	SIC Code	NAICS Code	NACE Code
Aerospace & Defense	372 & 376	3364	35.3
Apparel, Footwear & Leather Products	23, 31	315, 316	18.1-18.3, 19.2-19.3
Automotive	371, 375, 379	336	34.1-34.3, 35.4-35.5
Building Automation	15, 3534, 3564	3339, 3334	45.4
Electrical	36 (except 365,366,367)	335	31.1-31.6
Electronics & Semiconductors	357, 365, 366, 367	3341, 3342, 3343, 3344, 3346	30.0, 32.1-32.3
Fabricated Metal Products	34	332	28.1-28.7
Furniture & Wood Products	24, 25	3219, 3371, 3372	20.1-20.5, 36.1
Machinery *	35 (except 357)	333	29.1-29.7
Medical Products	384, 385	3391	33.1
Plastic & Rubber Products	30	326	25.1, 25.2
Printing & Publishing	27	511, 323	22.1-22.3
Other Discrete	381, 382, 386, 387, 39	3345, 3399	33.2-33.5, 36.2-36.6

\* While most machinery manufacturers fall under this segment, there is also a large quantity of OEM equipment that ARC accounts for within the respective end user industries, which is excluded from the Machinery Industry. For example, controllers purchased as OEM components for food processing or food packaging machinery is included in the figure for the food & beverage industry and is not included in Machinery.

**Figure 2-4**

**Standard Industry Code Classifications - Service Industries**

Service Industries	SIC Code	NAICS Code	NACE Code
Retail - Food & Beverage	54	445	52.2
Retail - Other	52, 53, 55, 56, 57, 58, 59	44 (except 445), 45	52 (except 52.2)
Wholesale/Distributor - Food & Beverage	514	4224, 4228	51.3
Wholesale/Distributor - Other	50, 51 (except 514)	42 (except 4224, 4228)	51 (except 51.3)
Transportation & Logistics	42, 44, 45, 47	481, 482, 483, 484, 488, 492, 493	60.2, 61.1-61.2, 62.1-62.2, 63.1-63.4, 64.1

## Chapter 3

### Market Shares

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The pressure transmitter market, buoyed by a booming automation market, rose at above average rates to \$1.8 billion in revenues, a CAGR of over 10 percent since 2004. Revenue increases were largely driven by massive capital expenditures in the Oil & Gas industry to increase its exploration and production capacity to meet rising global energy demand. Pressure transmitter suppliers have benefited from such investment and expansion activities, and they have aligned their business goals to capitalize on growing industry segments and geographic regions that will enable them to increase market share. Regionally, revenue breakdowns reflected the oil and gas boom, with substantial increases in the Middle East. New plant construction in Asia continued to drive revenues. In North America, the

The pressure transmitter market, buoyed by a booming automation market and massive capital expenditures in the Oil & Gas industry, rose at above average rates to \$1.8 billion in revenues.

2005 hurricanes Katrina and Rita wreaked havoc on the U.S. refining and chemical plant infrastructure in the Gulf of Mexico, helping to drive automation shipments in 2006, as oil companies scrambled to get refineries back on line to satisfy ever increasing demand for gasoline. Repairs are still underway, and they should continue through 2007.

Leaders of the worldwide pressure transmitter market, leveraging ongoing technological developments, such as the availability of more powerful microprocessors, reliable electronics, and embedded technology, continue to offer customers transmitters that are increasingly accurate, reliable, and functionally rich. With a variety of suppliers from which to choose, and advanced features such as plant asset management that give users a window into the health of their equipment and processes, users are applying pressure transmitters more extensively in their plants. The market leaders are all full line pressure transmitter suppliers who continue to bring innovative developments to the marketplace.

#### Leading Suppliers

In many respects, the market landscape has changed little since 2004. Emerson Process Management maintained its position as the leading supplier of pressure transmitters, with 44 percent market share. By virtue of its leadership position in the burgeoning Asian market, Yokogawa is the sec-

ond leading global supplier controlling roughly 21 percent of the global market. With a little over seven percent market share, Endress+Hauser continues its strong performance as the third leading global supplier of pressure transmitters. As an independent supplier with an instrumentation focus, the company's opportunities to win larger projects have been somewhat limited, but we expect that to change with Endress' recent alliance with Rockwell Automation. ABB is also a global pressure transmitter leader, with nearly seven percent market share. Rounding out the 2006 field of market leaders are Fuji Electric Systems and Honeywell.

### Emerson Process Management

Emerson is the leading supplier of pressure transmitters in all regions with the exception of Asia. It is also the leading supplier to the Chemical & Petrochemical and Oil & Gas industries, which together account for approximately 44 percent of the worldwide pressure transmitter market.

The company offers an extensive portfolio of field instruments, control valves, and control systems that allows Emerson to provide complete automation solutions to meet process manufacturers' needs for a wide range of applications. Emerson has been successful in leveraging this broad product portfolio in winning major projects. The company also has corporate purchasing agreements with several large multinational manufacturers, which also contribute to Emerson's market leading position. The company's acquisition of instrument supplier Solartron Mobrey in 2005 also helped to boost Emerson's market share.

Rosemount, the division of EPM responsible for pressure transmitters, invests heavily in research and development activities to continually improve its products and develop new ones. As a result, the company is a technology leader in terms of performance and reliability, being the first to offer PAM diagnostics for pressure transmitters, helping users to determine when impulse lines are plugged. Rosemount also developed the coplanar design, and more recently introduced "super" modules, which offer improved accuracy and integral accessories, such as valve manifolds. Emerson has also been a leading player in the development and proliferation of digital fieldbus communications, through its involvement with HART and Foundation Fieldbus. Indeed, Emerson's AMS Suite for PAM applications gives them an edge in replacing older analog transmitters, and the availability of device diagnostics, combined with field devices connected via HART or Foundation Fieldbus, is a major driver for users to

upgrade their older devices, or adopt intelligent transmitters for new projects.

The model 3051S Ultra transmitter, which boasts +/-0.025 percent accuracy under reference conditions and lifetime warranty, is a typical example. The Ultra for Flow version of the 3051S offers extraordinary accuracy for flow applications of +/-0.04 percent of reading rather than percent of span, with improved turndown.

Emerson has also been actively involved in the development of industrial wireless standards, particularly WirelessHART. The company has made a strong push into the wireless space with the recent introduction of its Smart Wireless solutions, which combine Rosemount pressure and temperature transmitters with self-organizing wireless network technology and gateways, and the wireless AMS Suite; its Intelligent Device Manager predictive maintenance software seamlessly integrates with DeltaV and Ovation automation systems, or legacy hosts. Available as a Wireless SmartPack Starter Kit, pressure transmitters are configured out of the box to quickly send process data via wireless to plant control systems. With such easy-to-use products, users no longer have an excuse not to try wireless in their plants, and the combination of wireless technology with Emerson's commanding lead in the pressure transmitter market ensures that the company will remain a potent competitor for years to come.

### Yokogawa

Yokogawa is the second leading pressure transmitter supplier with slightly more than 22 percent share of the global market. Yokogawa continues to be the leading supplier in the Asia Pacific region, which has seen breakneck growth in recent years, particularly in China, where the company has been able to leverage the boom in plant construction to improve its market position.

With pressure transmitter production facilities located in Japan, Yokogawa has a competitive advantage in terms of getting product to users in the region. It also has a greater understanding of the culture, business practices, and customer expectations. Yokogawa is also the number two supplier of smart pressure transmitters.

The company is targeting the Asian and North American markets in particular for pressure transmitter growth. Yokogawa was successful in gaining market share in the global Oil & Gas industry, and in the North

American market in particular, as a result of several projects wins related to Canada's oil sands reclamation efforts. Committed to pursuing this business, Yokogawa has recently opened an office in Calgary to support its efforts. The company has also been successful in addressing the pressure transmitter requirements of the Electric Power and Metals industries.

Yokogawa pressure transmitters use a digital silicon resonant sensor that makes the devices resistant to output drift, and provides long-term stability, up to 15 years, according to Yokogawa. Recognizing the importance of digital connectivity to field devices, the company has invested heavily in transmitters that support the HART and Foundation Fieldbus protocols.

#### **Endress+Hauser**

Emerging from its roots as a regionally focused level measurement specialty company, Endress+Hauser has evolved to become a leading global provider of process measurement and analytical technologies and associated services, and it is the largest independent instrumentation supplier to the process industries. The Endress+Hauser Group structure is characterized by interconnected, but legally independent, companies whose activities are coordinated by a central management company. Such a structure enables a degree of flexibility to meet the specific needs of different markets, industries, and country requirements.

Although the bulk of the company's sales continue to be derived from Europe, E+H's efforts to further penetrate other geographic regions have enabled it to emerge as the third leading global supplier of pressure transmitters in 2006. Despite its strengths, E+H is in a distant second place in the EMEA region, likely due to large oil and gas projects won by Emerson Process Management in the Middle East. However, E+H is working to expand their presence in this key market by organizing a dedicated Oil & Gas industry group, which organizes sessions to uncover user needs and explore dedicated solutions for challenging applications.

E+H is at something of a disadvantage in comparison to the two market leaders in winning large projects, as it does not offer process automation systems (PAS) with which to leverage their instrumentation. To overcome this disadvantage, the company has entered into some synergistic partnerships with other major suppliers who are strong in systems, but weak in process instrumentation, such as Honeywell, Metso Automation, and Rockwell Automation. These partnerships have provided E+H with increased market penetration that may not have been possible otherwise. Through its

relationship with Rockwell, the company has gained significant presence in North America and in the hybrid space in the Food & Beverage and Pharmaceutical industries, where Rockwell has a substantial footprint.

Endress+Hauser is also a field device technology innovator, having applied for nearly 180 patents in 2006. Their strong commitment to R&D enhances their ability to compete with even the largest suppliers.

#### **ABB**

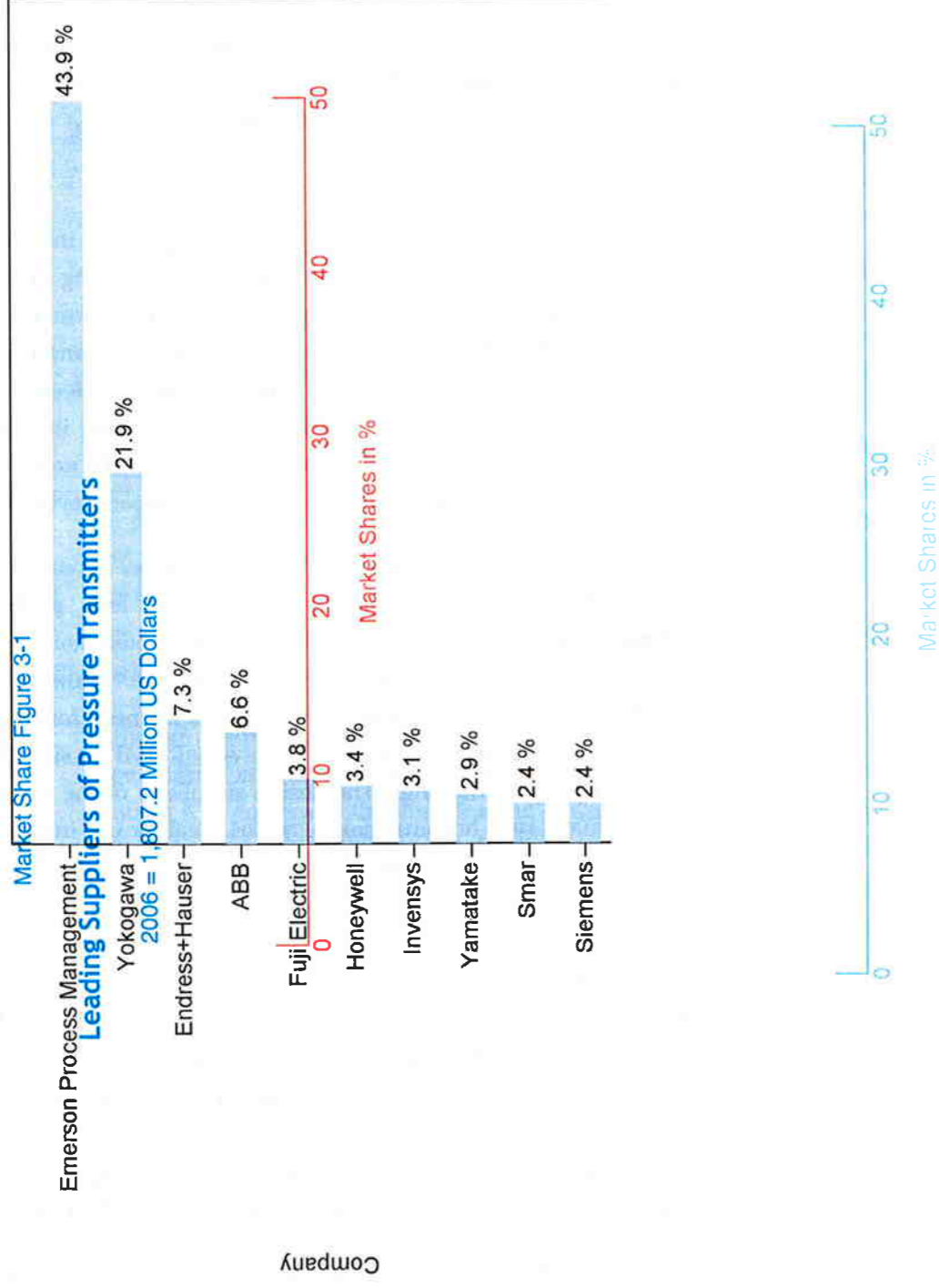
With about 6.6 percent market share, ABB maintained its status as a major pressure transmitter supplier. The company's standing in the worldwide pressure transmitter market is largely due to its performance in the North America and EMEA regions where it holds the fourth and third share positions, respectively. ABB also credits a strong focus on customer requirements, and increased market awareness about its instrumentation products for its success. ABB's recent introduction of a new line of pressure transmitters will help to secure their place as a major player in the market.

The innovative design of the model 364 eliminates the need for bolts, gaskets and flanges, thus eliminating potential leak paths. Standard construction includes a lightweight all stainless steel housing and process connection making it suitable for corrosive service. Transmitter stability of +/-0.15 percent of span for ten years reduces the need for frequent calibration. The 364 also features ABB's Universal HMI to simplify operation, maintenance and training. The design simplicity of the single piece body and stainless steel housing makes the 364 ideal for use in the Oil & Gas industry, and the elimination of leak paths and a standardized HMI offers lower total cost of ownership.

#### **Other Leaders**

Fuji Electric Systems and Honeywell round out the field of leading pressure transmitter suppliers with each capturing about four percent global market share. Fuji, strong in the Asian market and has a respectable presence in the Water & Wastewater, Chemical and Mining industries. The challenge facing Fuji is to increase its penetration in other regions, particularly in North America, where it has already made significant progress.

Honeywell, the number two supplier in North America, is also a leading supplier in the Oil & Gas and Refining industries. A strong proponent of wireless, Honeywell should be able to leverage this important technology to increase its share of the pressure transmitter market.

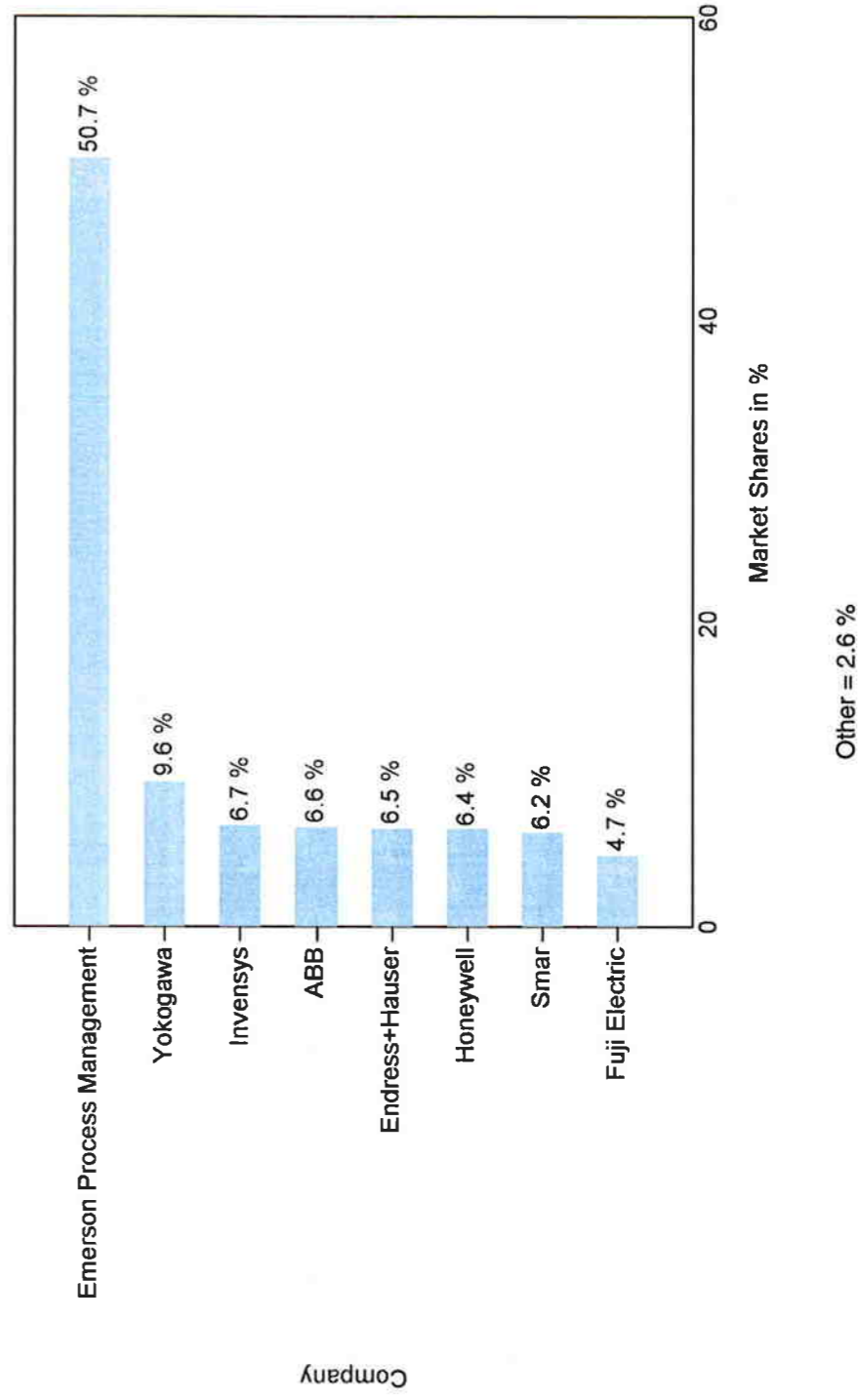


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Market Share Figure 3-2

**Leading Suppliers of Pressure Transmitters for North America**

2006 = 453.4 Million US Dollars

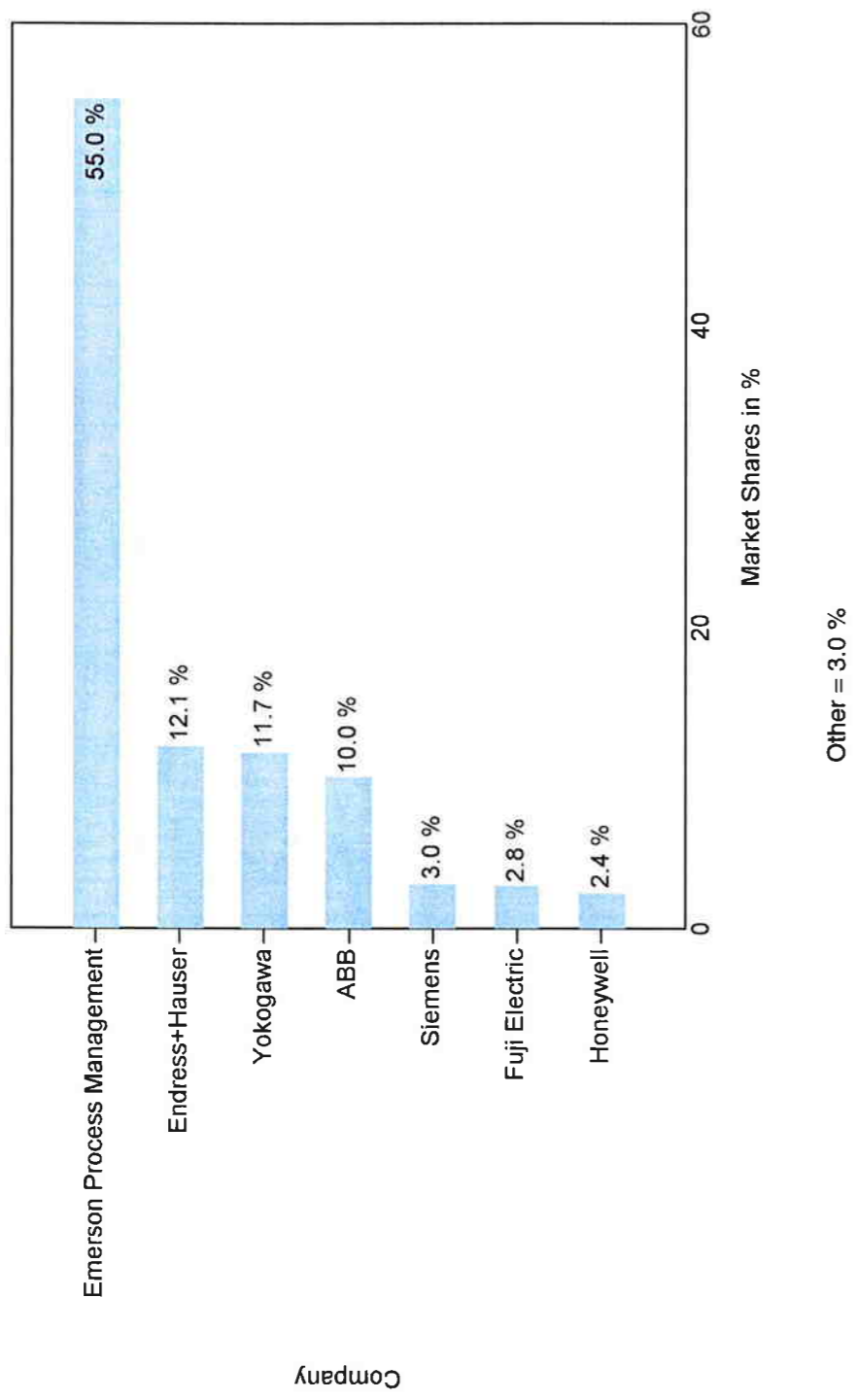


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Market Share Figure 3-3

### Leading Suppliers of Pressure Transmitters for EMEA

2006 = 591.1 Million US Dollars

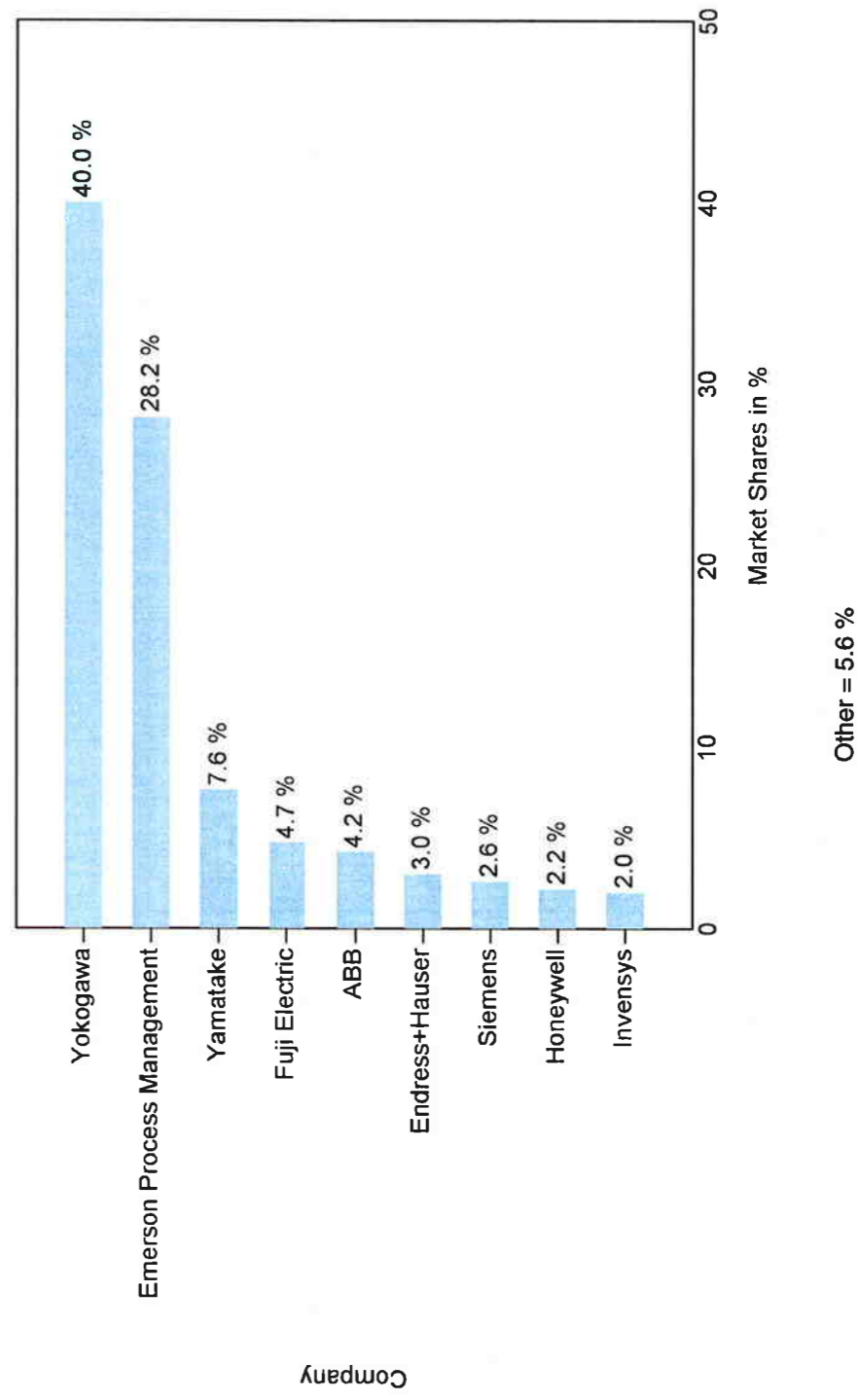


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Market Share Figure 3-4

### Leading Suppliers of Pressure Transmitters for Asia

2006 = 674.4 Million US Dollars

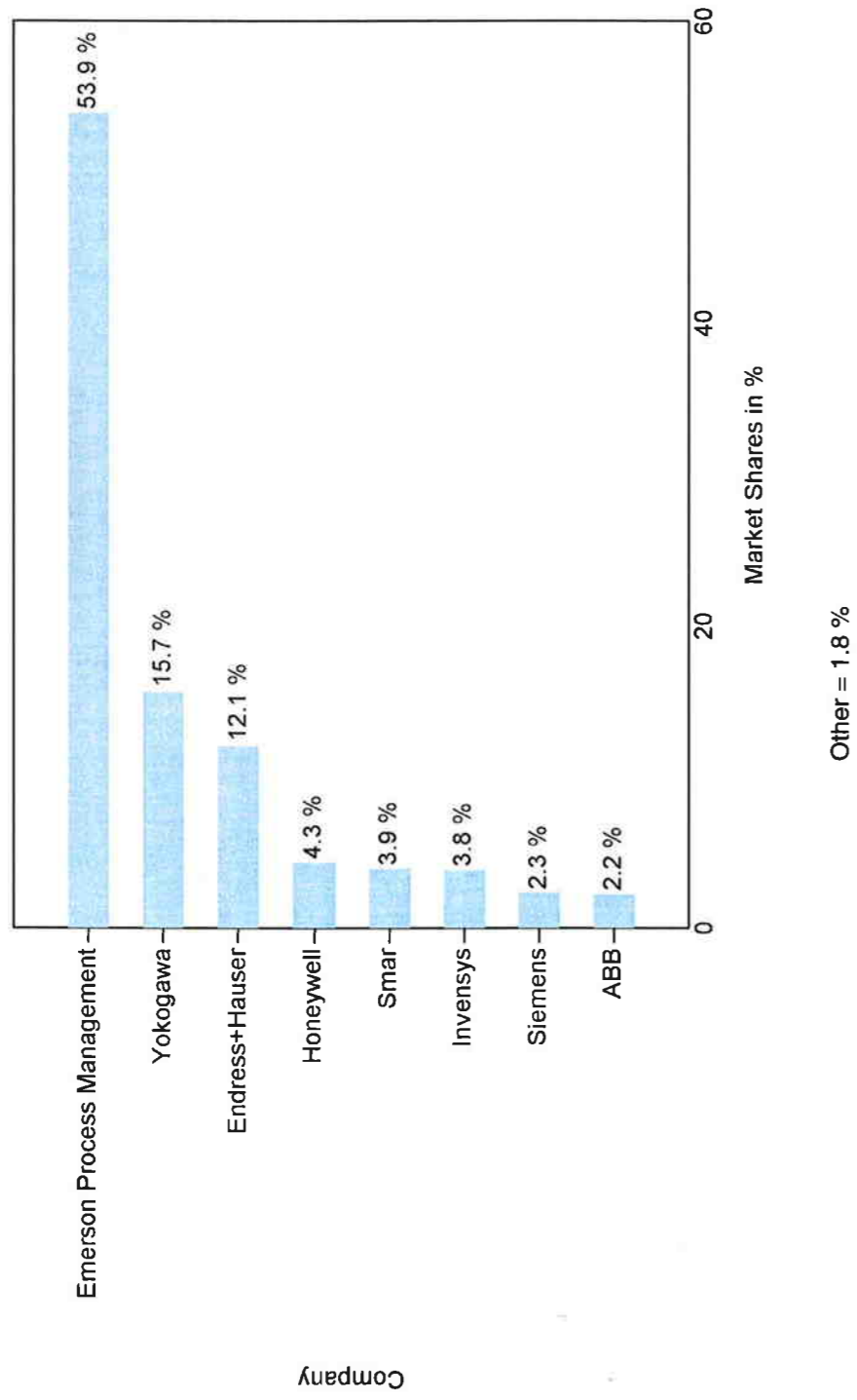


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Market Share Figure 3-5

### Leading Suppliers of Pressure Transmitters for Latin America

2006 = 88.3 Million US Dollars

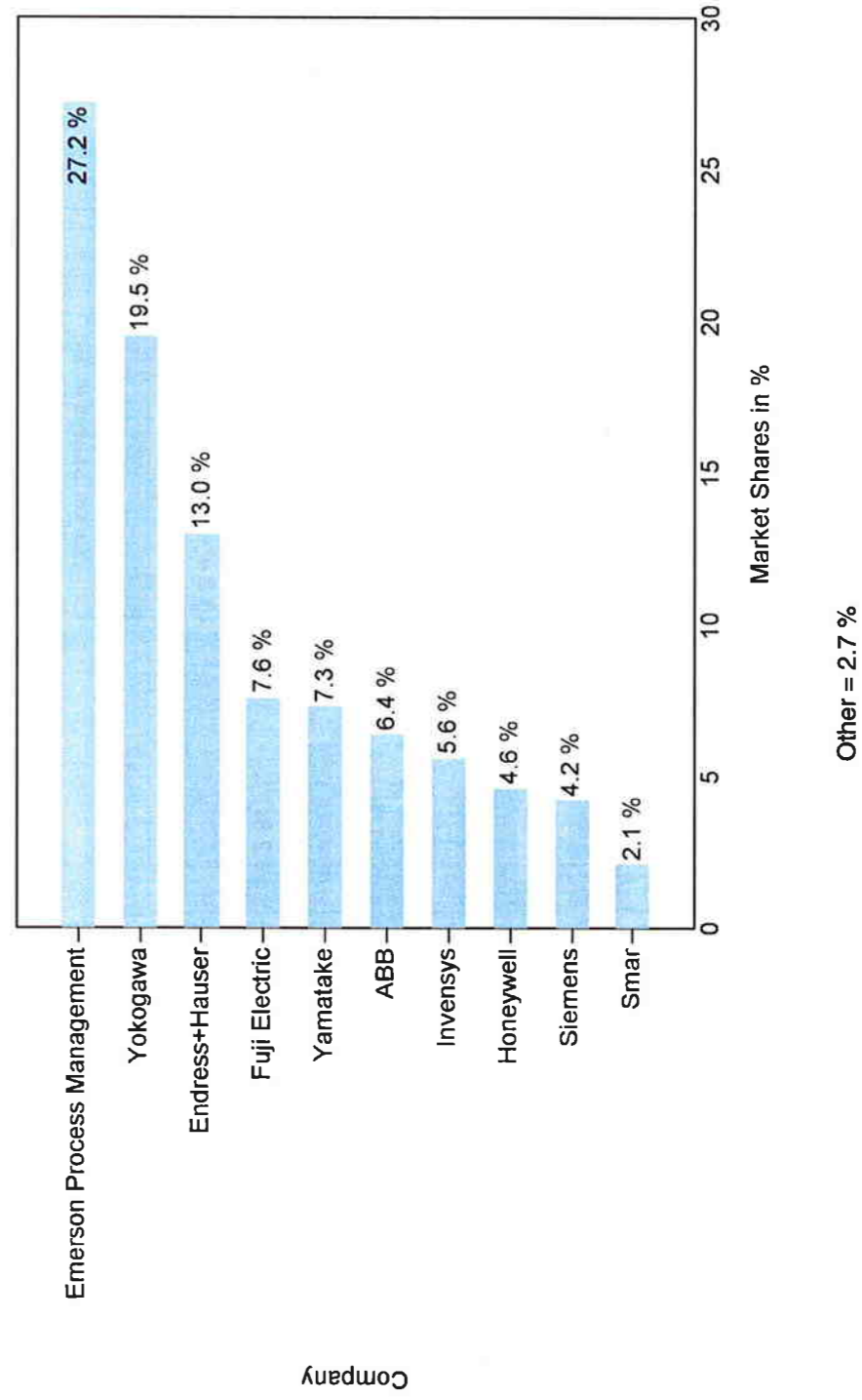


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Market Share Figure 3-6

### Leading Suppliers of Pressure Transmitters for Chemical

2006 = 203.7 Million US Dollars

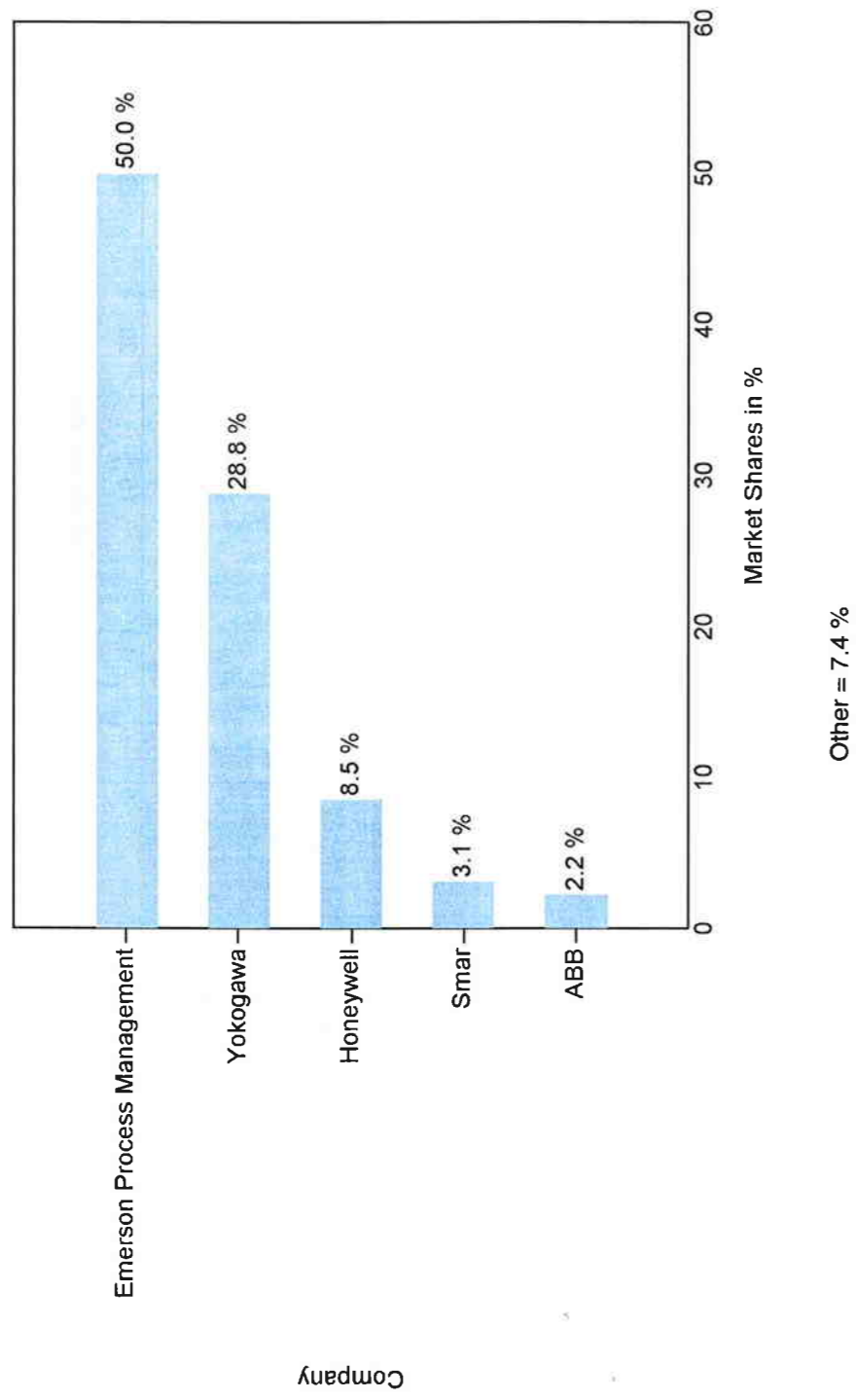


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Market Share Figure 3-7

### Leading Suppliers of Pressure Transmitters for Refining

2006 = 206.3 Million US Dollars

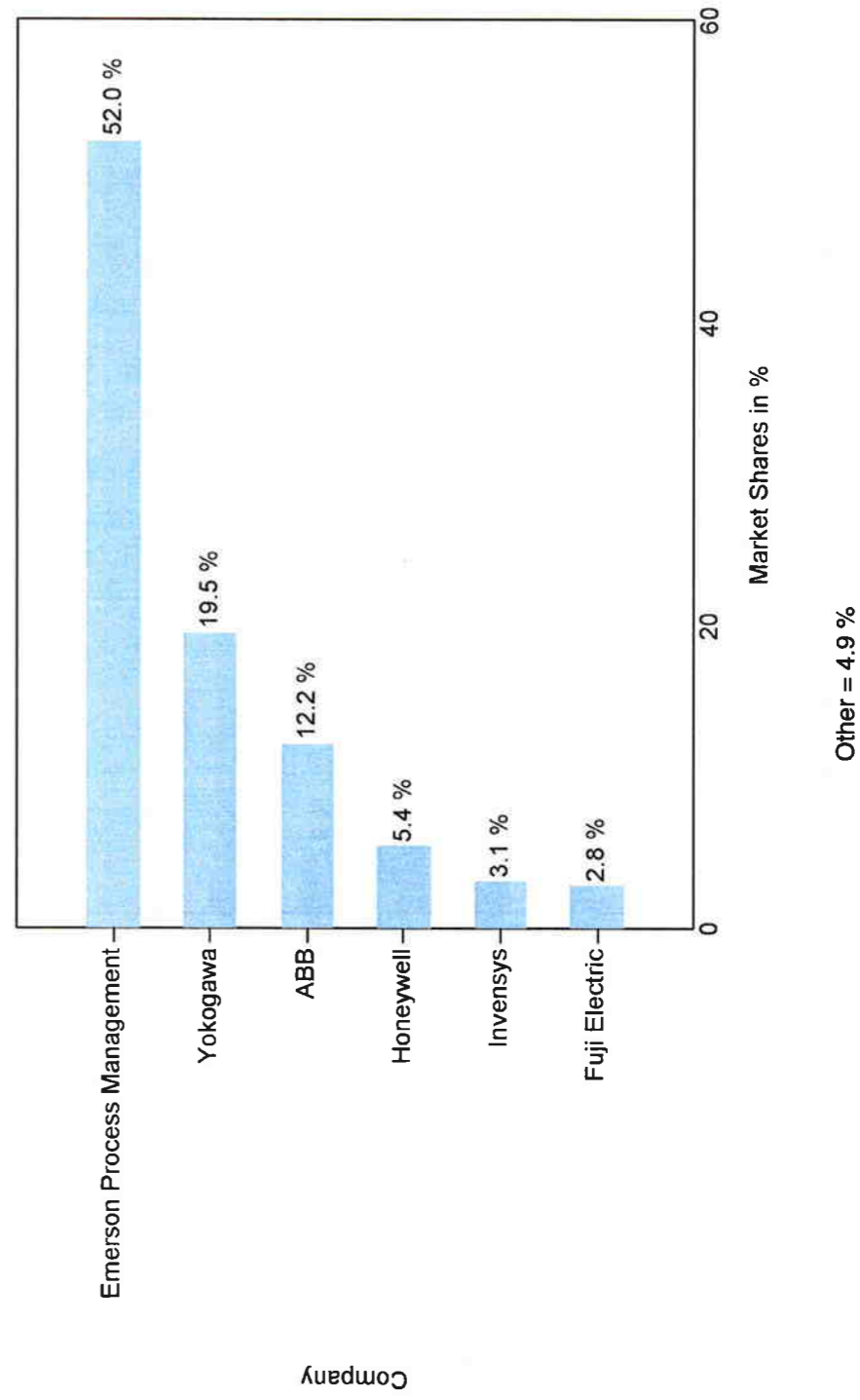


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Market Share Figure 3-8

### Leading Suppliers of Pressure Transmitters for Oil & Gas

2006 = 365.5 Million US Dollars

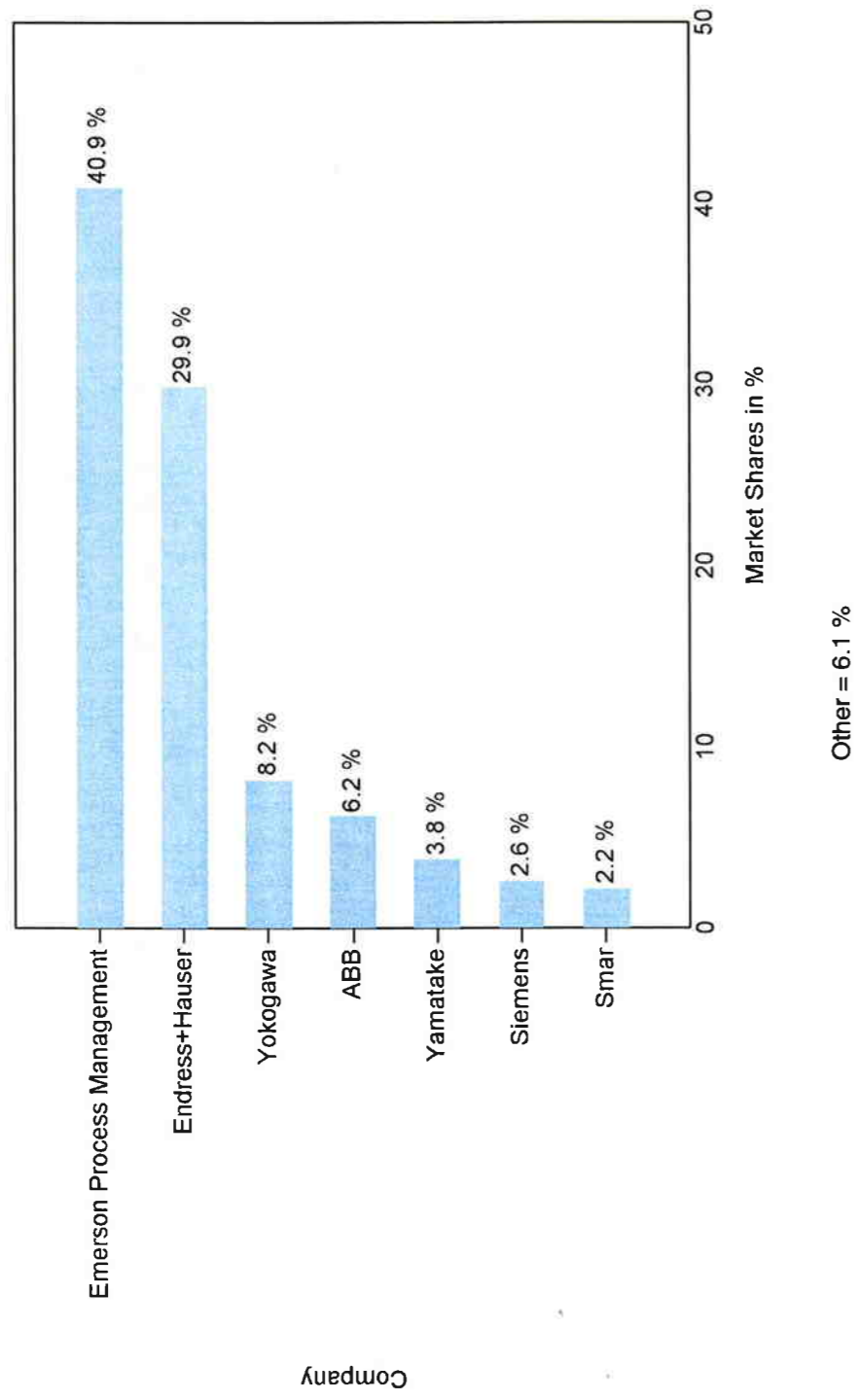


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Market Share Figure 3-9

### Leading Suppliers of Pressure Transmitters for Food & Beverage

2006 = 96.9 Million US Dollars

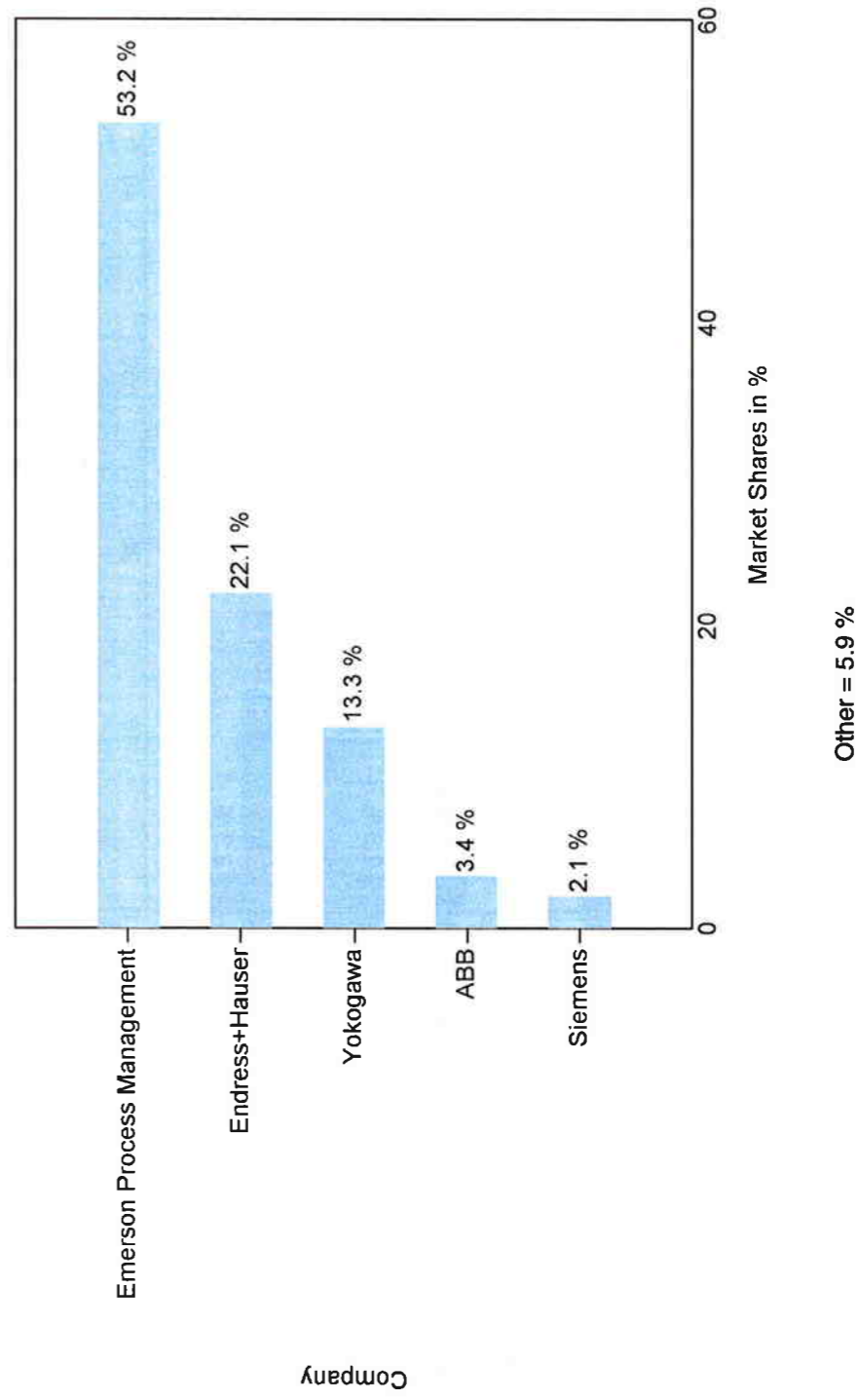


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Market Share Figure 3-10

### Leading Suppliers of Pressure Transmitters for Pharmaceutical & Biotech

2006 = 59.6 Million US Dollars

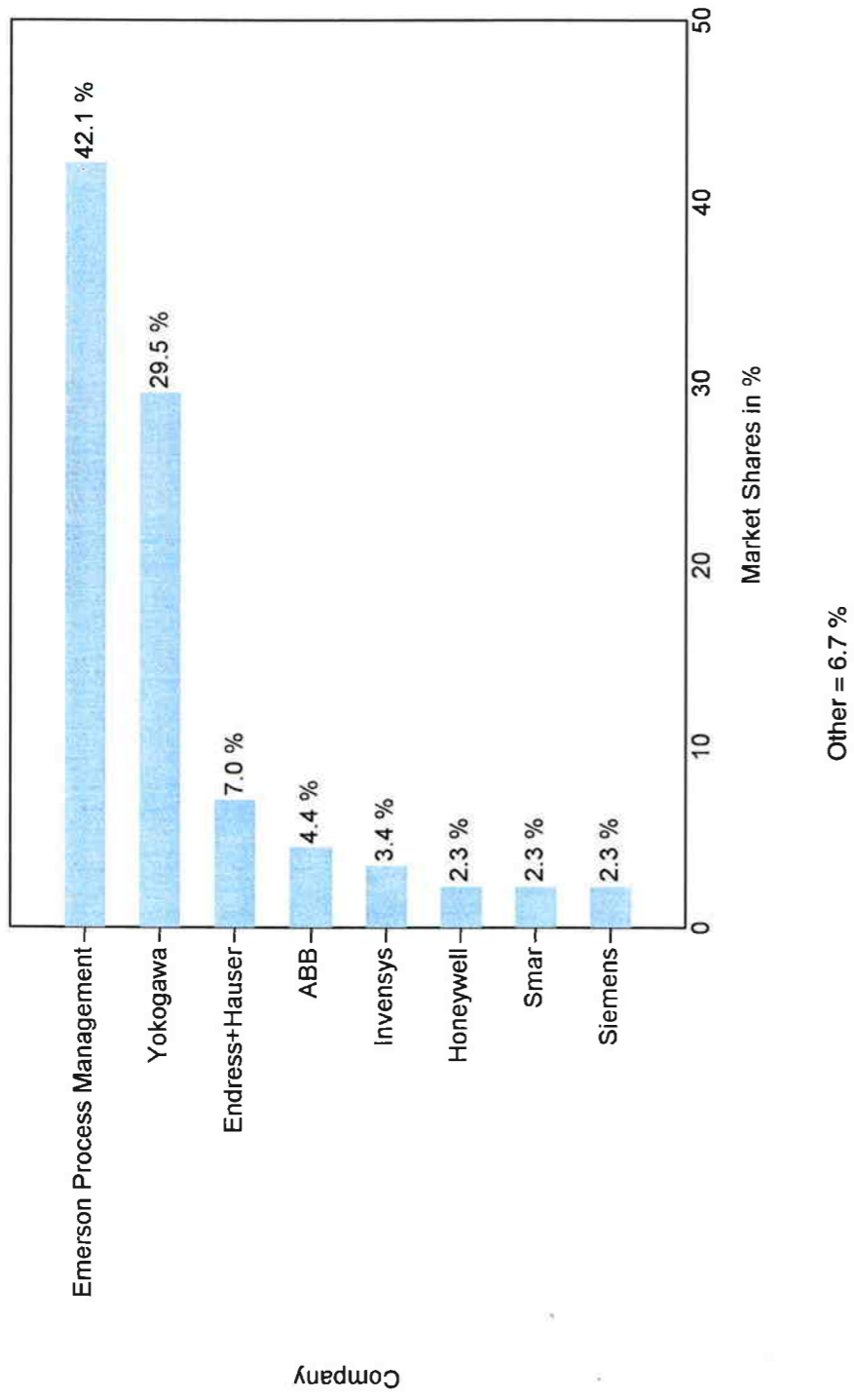


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Market Share Figure 3-11

### Leading Suppliers of Pressure Transmitters for Pulp & Paper

2006 = 94.1 Million US Dollars

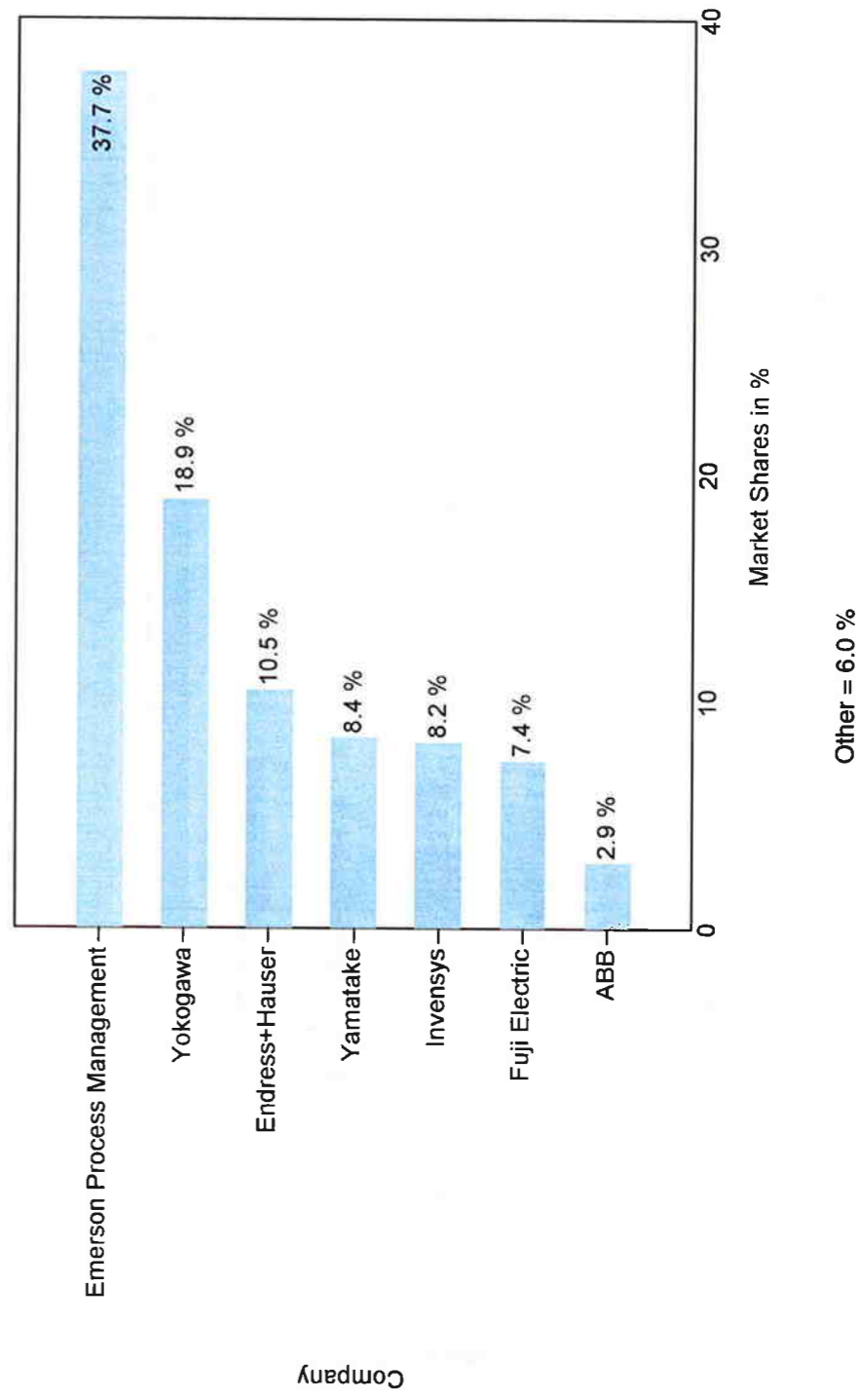


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Market Share Figure 3-12

### Leading Suppliers of Pressure Transmitters for Mining & Metals

2006 = 63.0 Million US Dollars

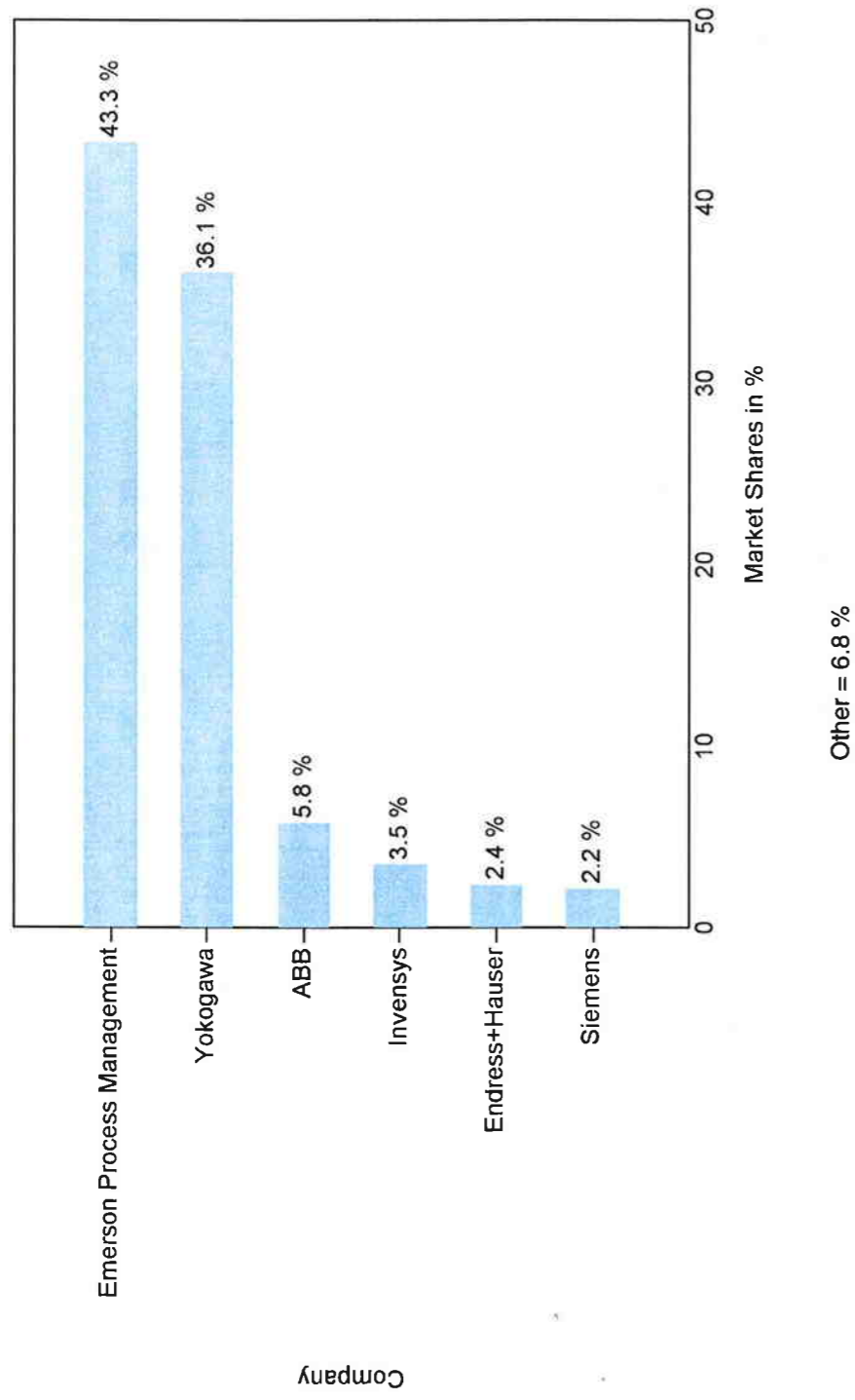


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Market Share Figure 3-13

### Leading Suppliers of Pressure Transmitters for Petrochemical

2006 = 274.7 Million US Dollars

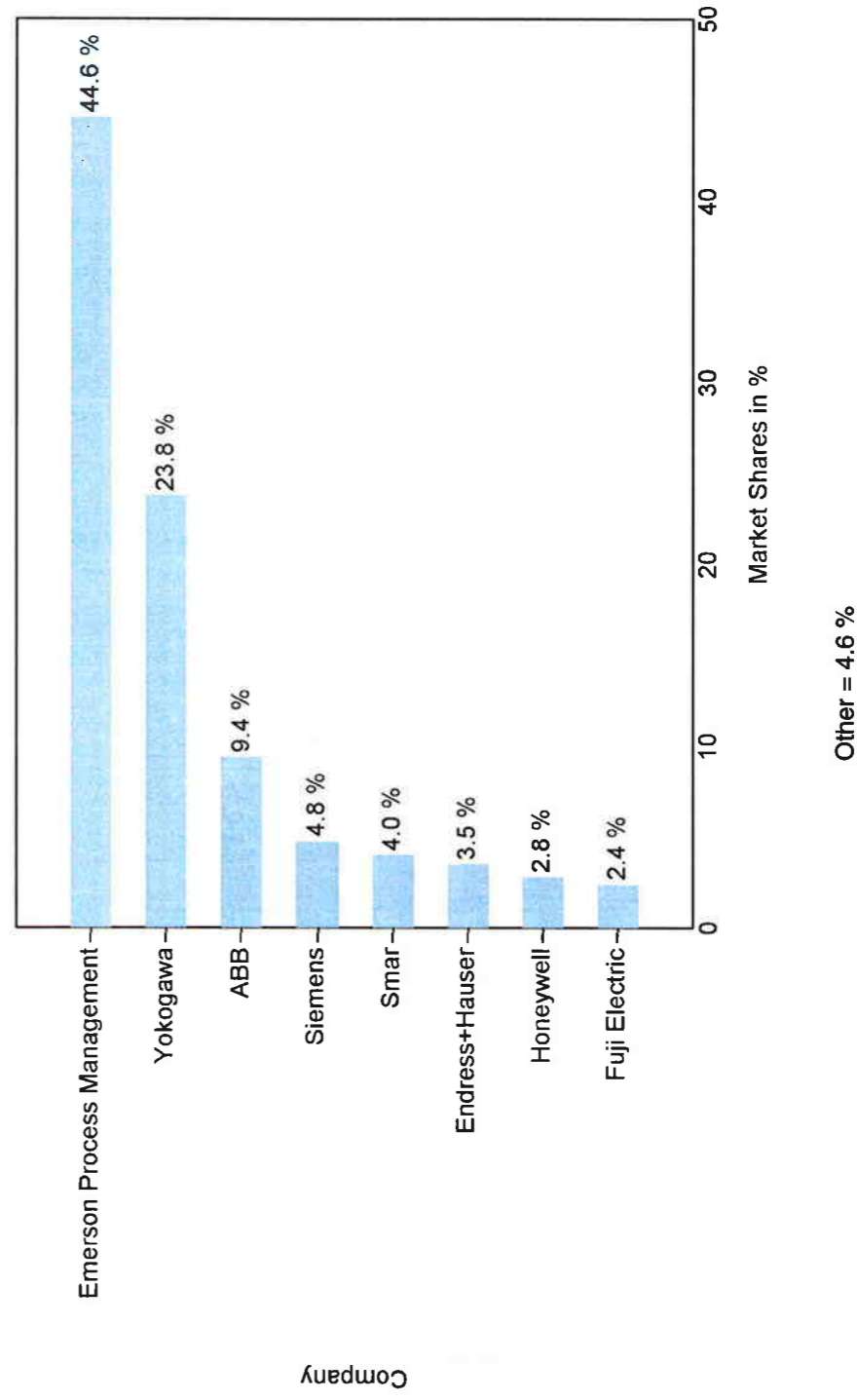


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Market Share Figure 3-14

### Leading Suppliers of Pressure Transmitters for Electric Power

2006 = 266.5 Million US Dollars

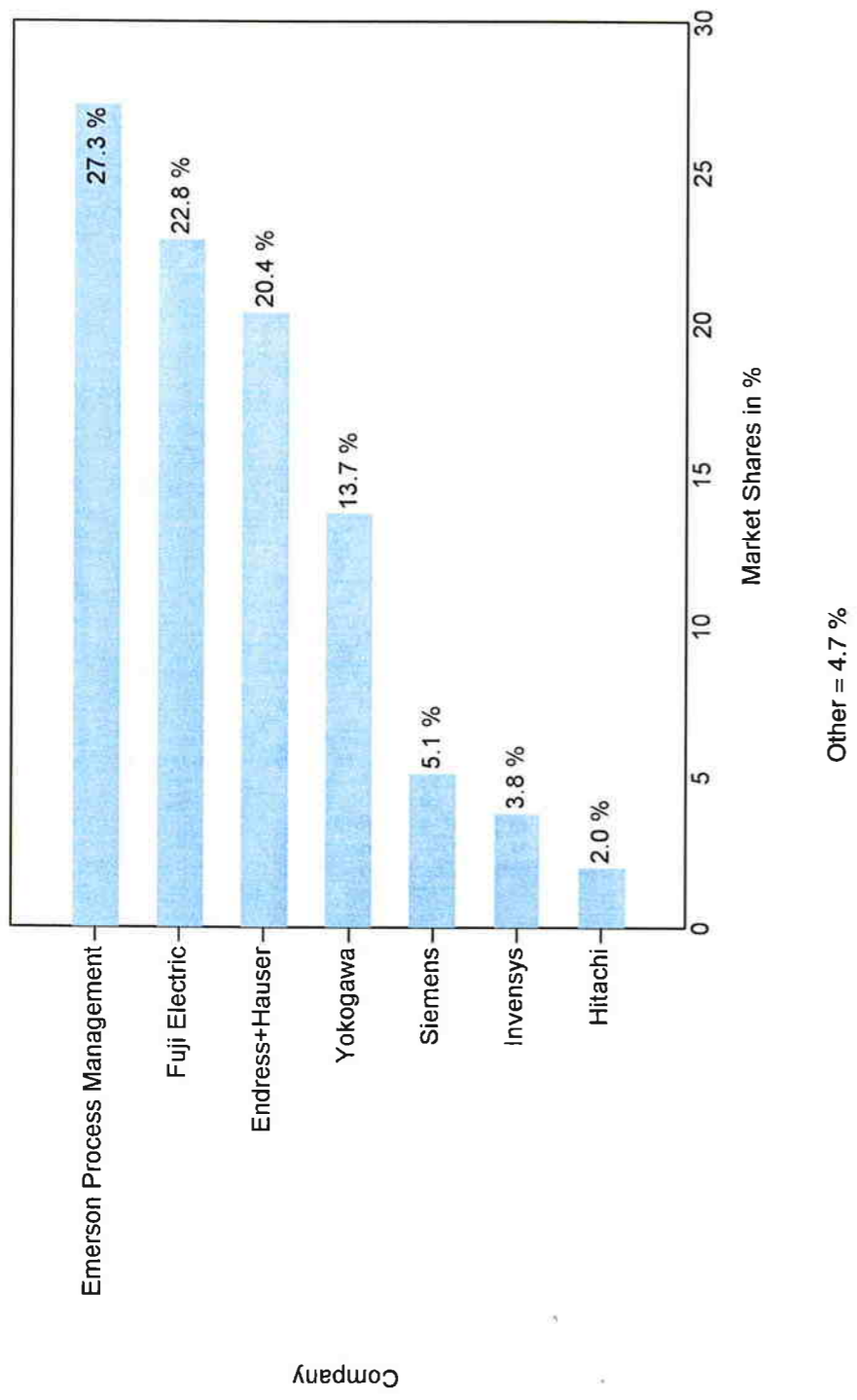


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Market Share Figure 3-15

### Leading Suppliers of Pressure Transmitters for Water & Wastewater

2006 = 58.0 Million US Dollars

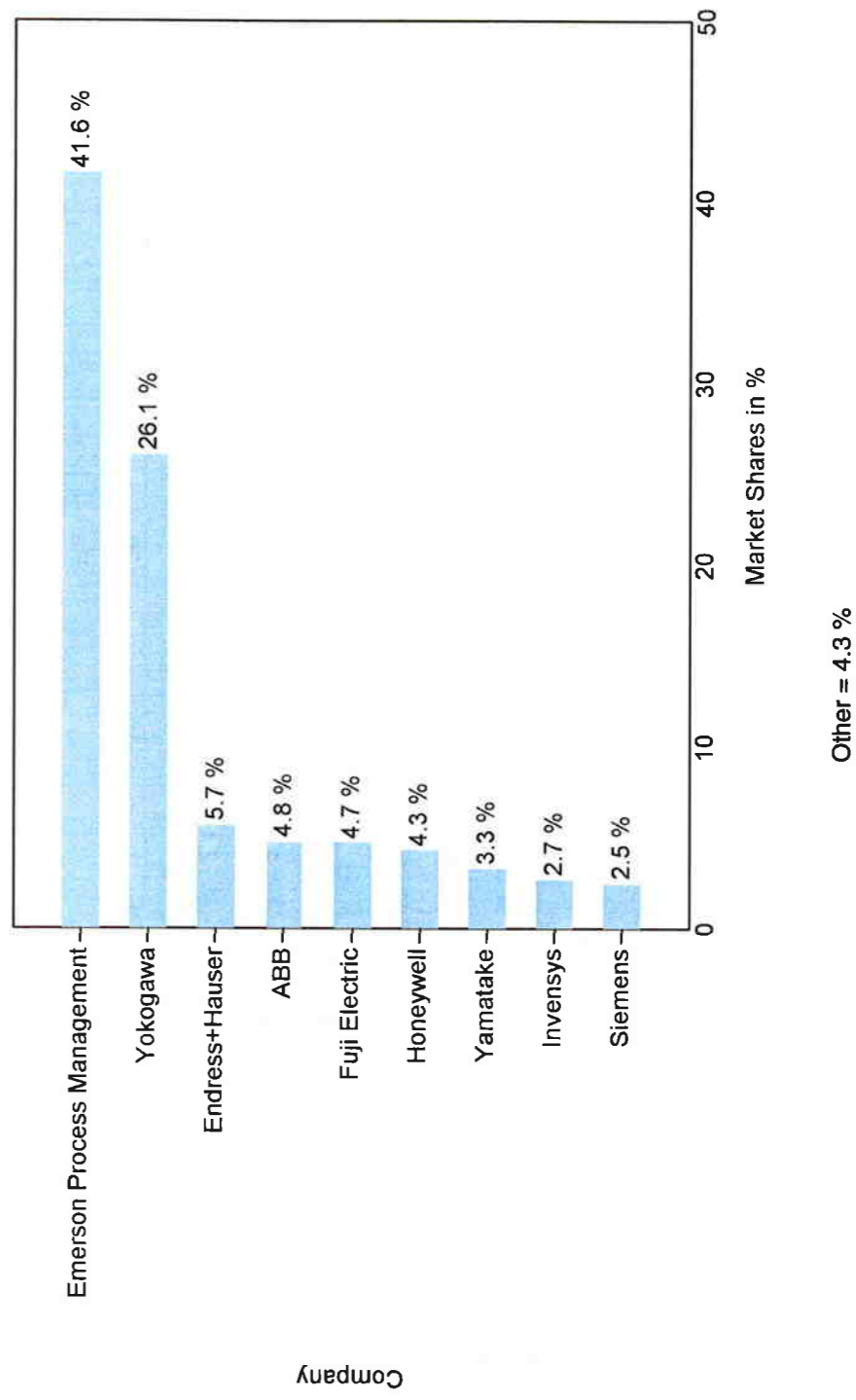


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Market Share Figure 3-16

### Leading Suppliers of Pressure Transmitters for Differential Pressure

2006 = 942.9 Million US Dollars

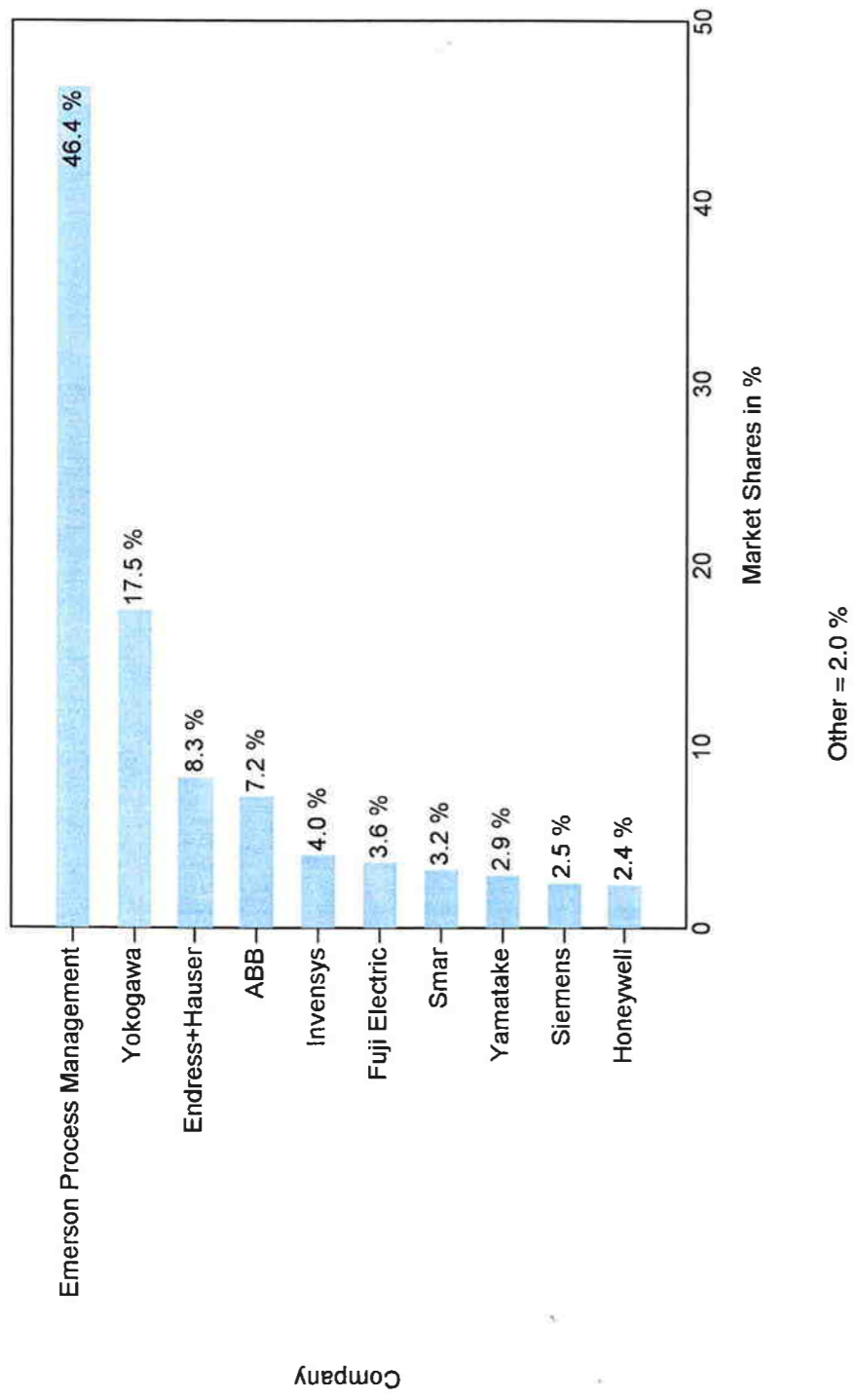


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Market Share Figure 3-17

### Leading Suppliers of Pressure Transmitters for Gauge Pressure

2006 = 680.5 Million US Dollars

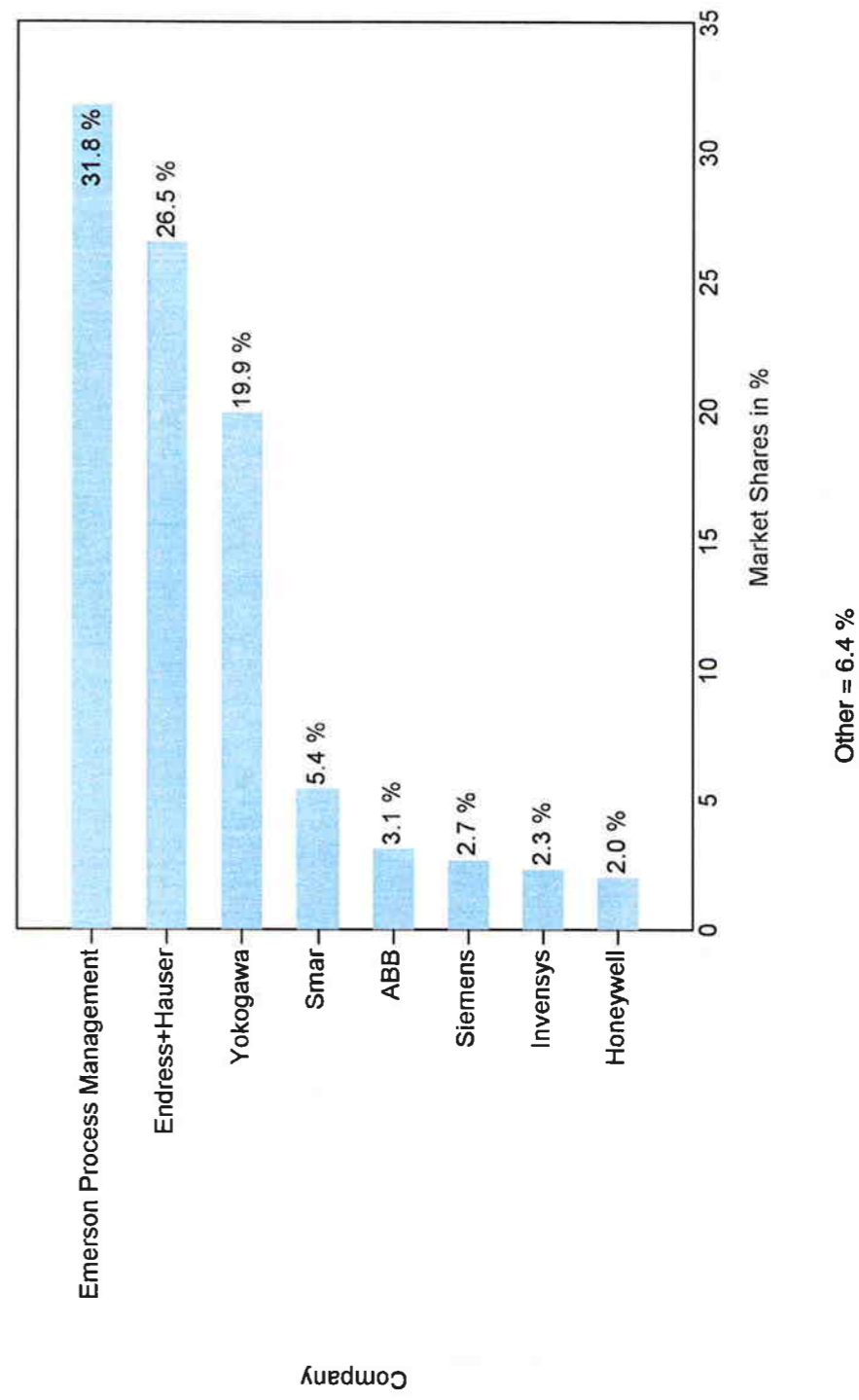


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Market Share Figure 3-18

### Leading Suppliers of Pressure Transmitters for Absolute Pressure

2006 = 79.8 Million US Dollars

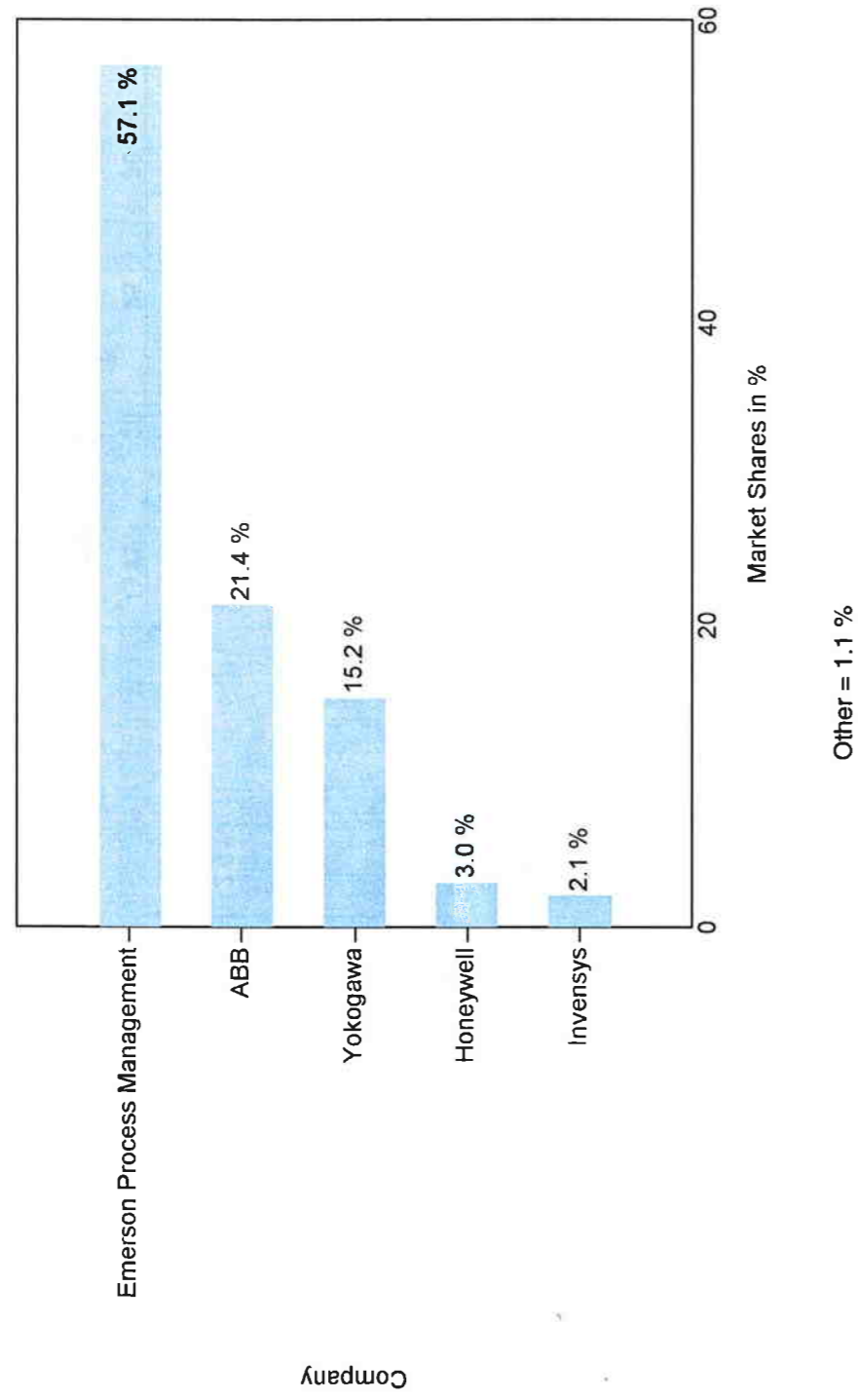


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Market Share Figure 3-19

### Leading Suppliers of Pressure Transmitters for Multivariable

2006 = 104.0 Million US Dollars

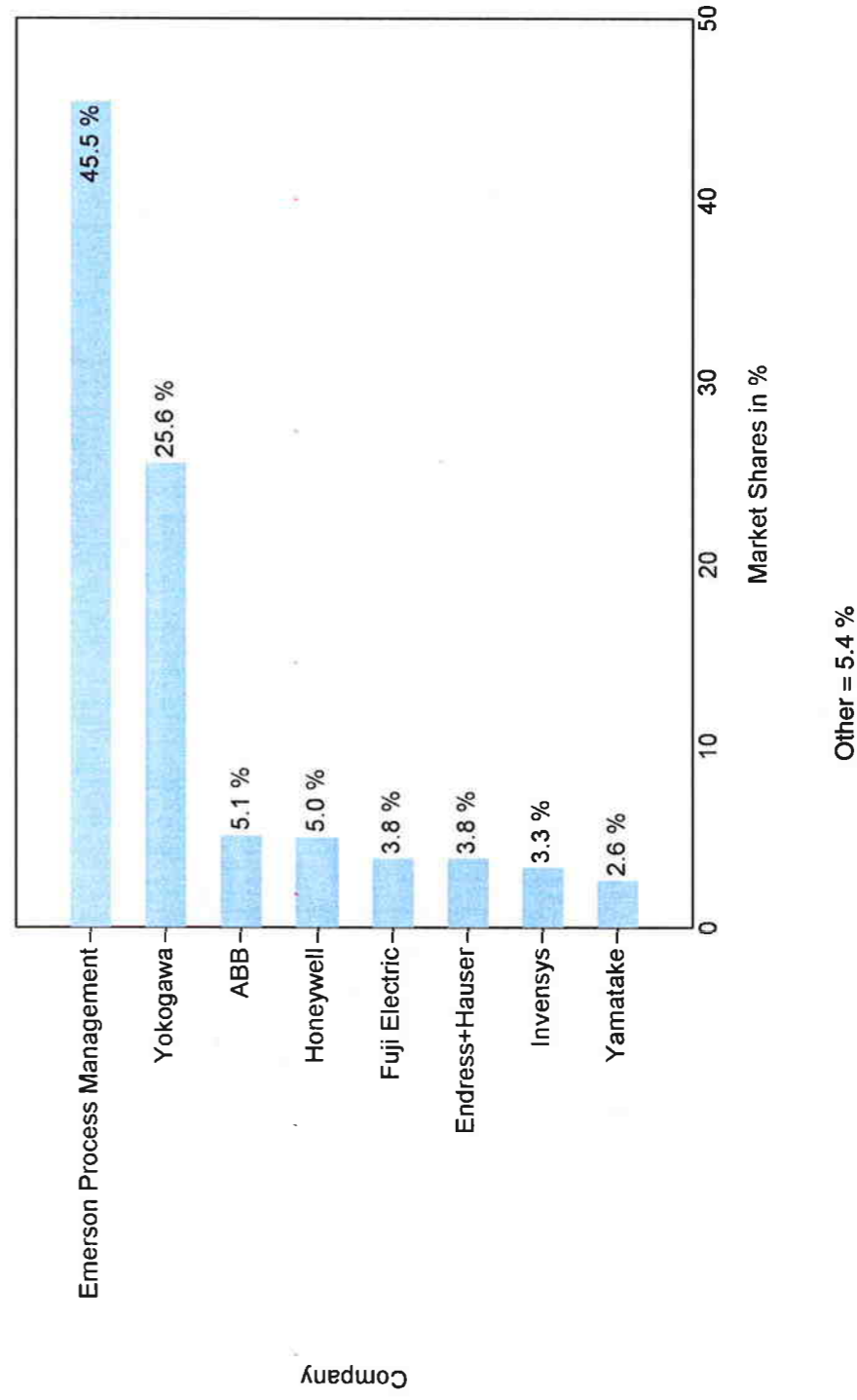


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Market Share Figure 3-20

### Leading Suppliers of Pressure Transmitters for Flow rate indication

2006 = 697.6 Million US Dollars

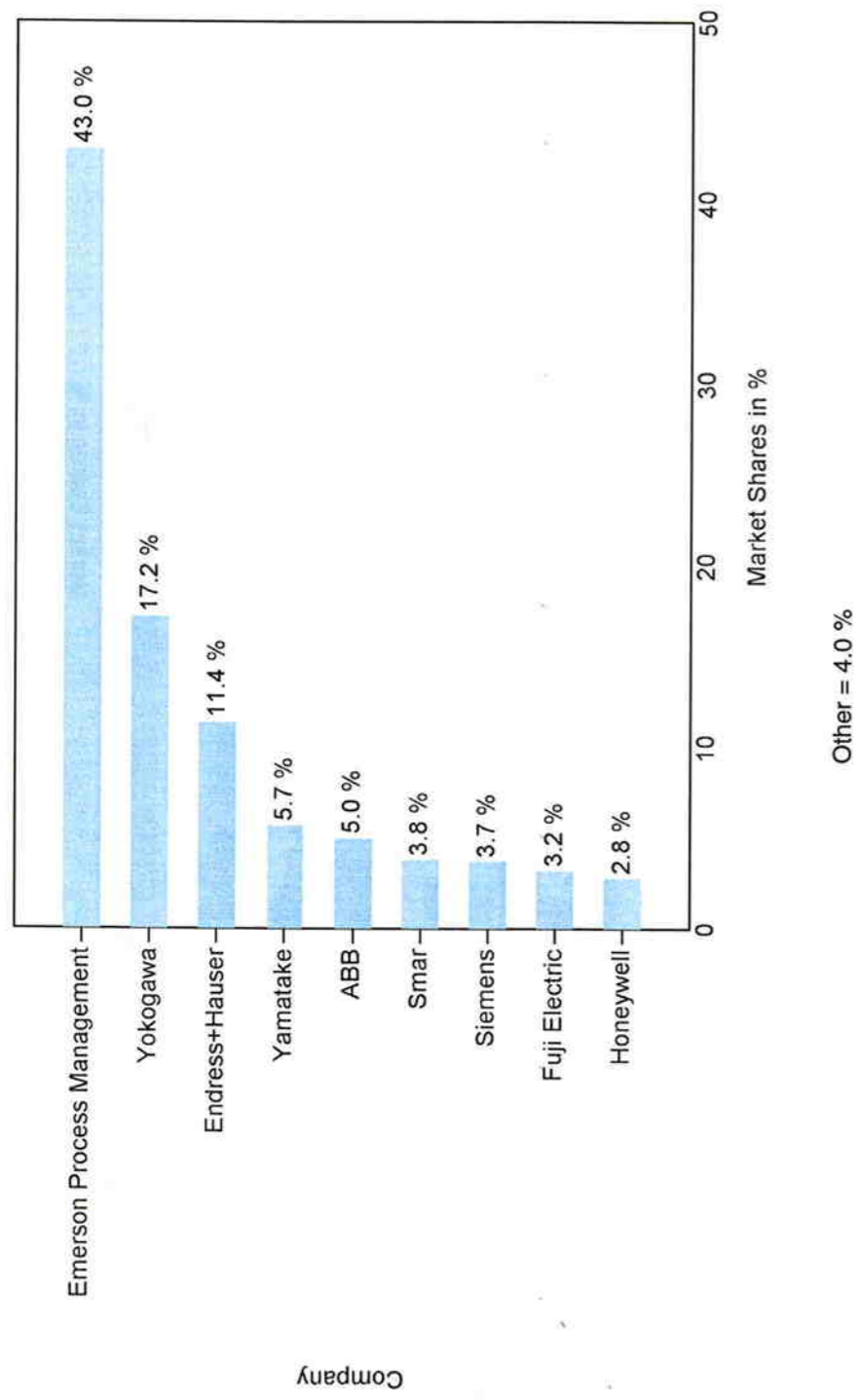


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Market Share Figure 3-21

### Leading Suppliers of Pressure Transmitters for Level Detection

2006 = 461.0 Million US Dollars

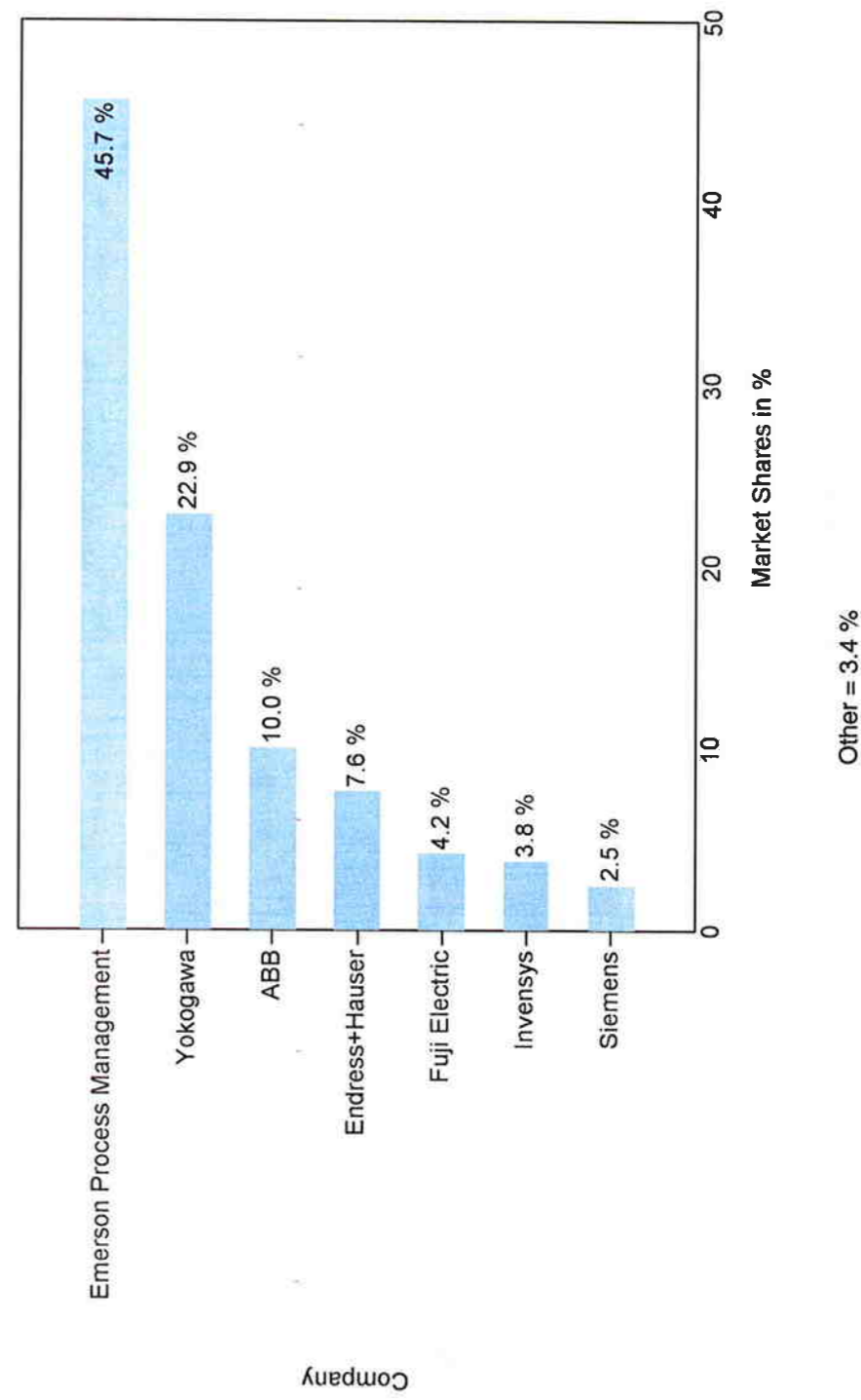


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Market Share Figure 3-22

### Leading Suppliers of Pressure Transmitters for Direct Pressure

2006 = 606.6 Million US Dollars



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## **Toshiba**

<http://www.toshiba.co.jp/worldwide/>

### **Key Products**

AP-3051

### **Regions**

North America; Europe, Middle East & Africa; Asia; Latin America

### **Description**

Toshiba Corporation is a leader in the development and manufacture of consumer products, information and communication systems, electronic devices and components, power systems, and social infrastructure systems. Toshiba employs 172,000 people worldwide with annual sales of over \$60 billion. Toshiba serves a variety of industries, including Information and Communications, Electronic Components and Materials, Semiconductors, Power Systems, Industrial, Transportation, Consumer, and Medical.

The Industrial and Power Systems & Services Company falls under Toshiba's Social Infrastructure business. The decline in demand for thermal power plants in North America has contributed to a decline in revenues in this business segment despite increasing demand for new power generation facilities in the Asia-Pacific region. The company's key strategies for business development include: expanding its presence in growing overseas markets, expanding its service business, and relying on core businesses in emerging markets.

Industrial and Power Systems & Services contributes close to one third of total corporate sales. Toshiba is a leading supplier of DCS and PLC. Industrial products also include AC drives, instrumentation, motors, motorstarters, switchgears, and UPS systems. The instrumentation products include density meters, electromagnetic flowmeters, hybrid controllers, integrated control systems, multi-loop controllers, recorders, and pressure transmitters.

### **Partnerships and Acquisitions**

**Partnerships:** Microsoft, Schneider, GE, Infineon, NEC, IBM

## **Strengths and Challenges**

**Strengths:** Broad product range that runs the gamut of automation control and measurement devices.

**Challenges:** Increasing market share beyond domestic Japanese market.

### **Key Industries**

Building Automation; Chemical & Petrochemicals; Oil & Gas; Power; Pulp & Paper; Water & Wastewater

## **Yamatake**

<http://www.yamatake.com/>

### **Key Products**

ST 3000 and 900 series

### **Regions**

North America; Europe, Middle East & Africa; Asia; Latin America

### **Description**

Yamatake provides solutions for process, building, and factory automation. With manufacturing facilities worldwide supported by R&D centers, Yamatake is a pioneer in developing new technologies in the field measurement and control market. The company is expanding its automation and controls sales globally. Yamatake has made significant investments to improve its support infrastructure, strengthen sales, and boost maintenance revenues in these markets. Yamatake coordinates its international operations through a single business unit. Yamatake is focusing on North America and developing markets in Asia to overcome sluggish demand in Japan, and for future growth. Yamatake has set up subsidiaries in many countries, including India and China in Asia, Europe, and the US. Yamatake has had great success in boosting distribution in North America, and has seen sales in the U.S. increase significantly.

Yamatake has a solid reputation for technically sound field instrumentation. The company supplies a full line of smart pressure transmitters. The company's PTG Series gage is a compact design with bilingual capability. The company is a co-founder of the Fieldbus Foundation and actively contributes to the development of communication protocols.

### **Partnerships and Acquisitions**

**Partnerships:** CEA-Leti

**Acquisitions:** Cornerstone division of Hunt Valve Company, Kimmon Mfg.

### **Strengths and Challenges**

**Strengths:** Technically strong products

**Challenges:** Expanding global presence beyond traditional domestic market

### **Key Industries**

Chemical & Petrochemicals; Food & Beverage; Mining; Oil & Gas; Oil & Gas Refining; Power; Pulp & Paper;

## Yokogawa

<http://yokogawa.com/>

### Key Products

EJX and EJA Series

### Regions

North America; Europe, Middle East & Africa; Asia; China; Latin America; India

### Description

Yokogawa Electric Corporation, headquartered in Tokyo, Japan, is one of the world's leading suppliers in industrial automation and control, test and measurement, and information systems. Yokogawa, with around 18,000 employees worldwide and annual sales of \$4 billion, has manufacturing facilities in Japan, China, Singapore, India, Germany, and The Netherlands.

Yokogawa operates through four main divisions: Industrial Automation and Control, Test and Measurement, Information Systems, and Industry Support. The Industrial Automation and Control division offers analytical instrument products, control systems, data acquisition systems, field instruments, and safety shutdown management systems.

Yokogawa is a member of Honeywell's PKS Advantage Program, a collaborative program by which third party field instrument vendors are integrating their products with Honeywell control systems. Honeywell will distribute Yokogawa's field instruments integrated with Honeywell control systems.

Yokogawa is a full line pressure transmitter supplier. The DPharp series of digital pressure transmitters utilize a differential pressure high accuracy silicon resonant sensor to achieve hysteresis-free performance and over-pressure protection. The resonator is fabricated from single silicon crystal in a vacuum cavity using 3-dimensional micro-machining techniques. The company recently announced the release of new function blocks for DPharp EJX Series Foundation Fieldbus Type transmitters enabling the transmitter to be updated in the field without having to make changes to the amplifier board assembly. The EJX can provide a discrete output signal for high/low alarm status and amplifier temperature can be monitored.

## Partnerships and Acquisitions

**Partnerships:** Fujitsu, GE Bently Nevada, Dresser (Masoneilan), IVT Corporation, Dräger

**Acquisitions:** Tonen System Plaza, Ando Electric Co., Ltd.

## Strengths and Challenges

**Strengths:** Strong position in domestic and Asian market. Leading supporter of digital fieldbus control systems. Strong FDT supporter. Increasing adoption of their recently enhanced PAM solution, Plant resource Manager (PRM) and Fieldmate.

**Challenges:** Increasing global market share, particularly in North America

## Key Industries

Chemical & Petrochemicals; Food & Beverage; Metals; Mining; Oil & Gas; Oil & Gas Refining; Pharmaceutical; Power; Pulp & Paper; Water & Wastewater

## Appendix A: Methodology

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Over the past two decades, ARC Advisory Group has become the leader in providing in-depth and accurate market intelligence for the industrial automation marketplace. From the beginning, our corporate goal has been total client satisfaction. We have continuously strived to refine and improve our vision of future plant automation systems. To meet the growing need for global market intelligence, we have recently expanded our services to cover the international marketplace.

ARC's research database is based on thousands of user surveys, telephone interviews, plant visits, and in-depth profiles of hundreds of suppliers and users. Our extensive network of industry contacts has been an invaluable asset in filtering out long-term trends from fads. Our consultants are skilled in analyzing and forecasting the impact of new technology and products on plant automation systems. We systematically study each market segment before developing specific recommendations for our clients.

ARC consultants follow technology and industry events on a daily basis, and have a broad range of expertise in all areas of industrial automation, including sensors, control systems, networks, computers, software, and services. We are experienced in working with all types of manufacturing processes including continuous, batch, discrete repetitive, and job shop.

Each year, ARC consultants attend the most important trade shows around the world. In addition, ARC consultants attend press conferences held by most major suppliers and review hundreds of news releases each year. ARC consultants then sort out real and long lasting trends in the marketplace.

ARC uses a five step approach to conduct global market research for the industrial automation marketplace. This approach provides our staff with a solid framework to formulate meaningful strategies for our clients. You can be assured that we give all areas of the study a considerable amount of time and thought before moving on to the next step. The following contains a brief description of how we conduct each of these five steps.

### Step 1: Client Inputs and Secondary Search

ARC started this project by inviting inputs from our primary clients and researching all secondary sources of information. Key secondary sources researched include the following.

#### ARC Database

ARC maintains a proprietary database on the industrial automation marketplace. This database provides our staff with a solid base to start their research project. The database includes the following information on several thousand companies:

- Annual Reports
- 10K and other Financial Reports
- Client Lists
- Price Lists
- Published Secondary Data on Companies and Products
- Market Size and Forecast Data
- Market and Technology Trend Data

#### Literature Search and Review

ARC subscribes to over 150 magazines and newspapers covering a wide range of topics relevant to the industrial automation community, as well as an extensive library of directories and books. We are on the news and product release mailing lists of every key user and supplier in the marketplace today. We sort and file important news and articles for future use. We research and analyze our in-house database and the prominent publications relevant to this study to identify:

- Issues of interest pertaining to the study
- Product and technology trends in the industry
- Changing user needs
- Manufacturer's products and key individuals within the study's scope

#### Sales and Financial Literature Requests

ARC requests capability brochures, catalogs, data sheets, application notes, and price lists from all known or potential manufacturers and suppliers of products pertinent to a study. We also request the following financial reports when needed:

- Annual reports

- 10K statements
- Prospectus and investment analyses

Our studies evolve rather than being forced. This assures you that the results are accurate, up-to-date, and meaningful.

### Step 2: Identify Key Issues

After discussions with clients and a careful review of all secondary information, ARC developed a list of key issues concerning both users and suppliers. In terms of elapsed time, ARC spent several weeks discussing issues pertinent to this study with the leading suppliers. We also capitalized on information contained in our previous market research reports and seminars on process control.

### Step 3: Gather Primary Data

#### Supplier Survey and Interviews

First, we conducted a top down analysis of the leading suppliers' products and various businesses in order to get a better understanding of the global business environment. Then we conducted telephone interviews with key individuals at all major suppliers. Where possible or necessary, we interviewed more than one person at each company to verify the accuracy of the information. We interviewed individuals typically engaged in one of the following functions at these companies:

- Product management
- Marketing management
- Product planning
- Sales management

#### Automation Profiles of the Leading Edge OEMs and Manufacturing Companies

ARC has compiled automation profiles of the leading edge OEMs and manufacturing companies. Some highlights of the information that is included in these profiles are:

- Plant automation budget of the company and how it is likely to change over the next five years.
- Open systems implementation plans and preferences of the company.

- What the top automation priorities are for the company and what portion of the budget is likely to be spent on control systems, sensors, computers, software, and systems integration.
- Enterprise-wide integration plans and strategies of the company by geographic region.
- Company preferences for different types of control systems, computers and software.

#### **Step 4: Data Analysis**

We organized and entered all gathered data into a computer database. The data was verified, sorted and cross-tabulated in numerous ways to filter out industry trends and answers to the key issues identified earlier.

After analyzing all market data, we prepared preliminary market forecasts. At this time, we considered many alternative scenarios and tested them against some key criteria. Finally, we chose the most accurate scenario.

#### **Step 5: Prepare Final Report**

After finalizing market forecasts, we drew charts and graphs to get further insight into user needs and wants. We spent a considerable amount of time and effort to draw conclusions and sort out long-term trends from fads. Finally, after we considered many different strategic alternatives, we developed recommendations for the industry participants.

#### **Benefits of ARC's Methodology**

Key benefits of ARC's methodology in conducting market research are:

- This is a proven approach and is designed specifically to conduct global market research for the industrial automation marketplace.
- Our staff members do all our research work. The ARC staff has first-hand industry knowledge and experience. Our staff's average level of industry experience is over twenty years.
- ARC actively solicits inputs from suppliers and users throughout the duration of a project.
- Our experienced staff conducts all interviews - not someone with absolutely no knowledge of the industry.
- We encourage independent thinking by our staff members.

- We can identify key individuals for interviews quickly and accurately through our extensive network of industry contacts and data base.
- We can complete each task very efficiently through our use of automated resources.

## Appendix B: Common Industry Abbreviations

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<b>4GL</b>	Fourth Generation Language
<b>μP</b>	Microprocessor
<b>3PL</b>	Third Party Logistics
<b>A/D</b>	Analog-to-Digital
<b>ABC</b>	Activity Based Costing
<b>AC</b>	Alternating Current
<b>ActiveX</b>	Object-Oriented programming language for Internet
<b>Ada</b>	Programming Language (named after Ada Lovelace)
<b>AEC</b>	Architect, Engineer & Constructor Firm
<b>AEGIS</b>	Abnormal Event Guidance Information System
<b>AGC</b>	Automatic Guidance Control
<b>AGV</b>	Automated Guided Vehicle
<b>AI</b>	Artificial Intelligence
<b>ALARP</b>	As Low as Reasonably Practicable
<b>ANSI</b>	American National Standards Institute
<b>APC</b>	Advanced Process Control
<b>API</b>	Application Program Interface
<b>Applet</b>	Small Software Application or Component
<b>APS</b>	Advanced Planning & Scheduling
<b>ARPANET</b>	Predecessor to Internet
<b>AS/RS</b>	Automatic Storage & Retrieval Systems
<b>ASIC</b>	Application Specific Integrated Circuit
<b>ASM</b>	Abnormal Situation Management
<b>ASN</b>	Advanced Shipment Notice
<b>ASP</b>	Application Service Provider
<b>ASP</b>	Average Selling Price
<b>ATM</b>	Asynchronous Transfer Mode
<b>ATP</b>	Available-To-Promise
<b>B2B</b>	Business-to-Business
<b>B2C</b>	Business-to-Consumer
<b>BIOS</b>	Basic Input/Output System
<b>BISYNCH</b>	Binary Synchronous Communication
<b>BOL</b>	Bill of Lading
<b>BOM</b>	Bill of Material
<b>BOOT</b>	Build, Own, Operate, and Transfer
<b>BPA</b>	Business Process Automation

---

<b>CRAR</b>	Collaborative Forecasting & Replenishment
<b>CRM</b>	Customer Relationship Management
<b>CRP</b>	Capacity Requirements Planning
<b>CRT</b>	Cathode Ray Tube
<b>CSA</b>	Canadian Standards Association
<b>CSI</b>	Current Source Inverter
<b>CSR</b>	Customer Service Representative
<b>CTP</b>	Capable-to-Promise
<b>D/A</b>	Digital-to-Analog
<b>DAS</b>	Data Acquisition System
<b>DC</b>	Direct Current
<b>DC</b>	Distribution Center
<b>DCE</b>	Distributed Computing Environment
<b>DCOM</b>	Distributed Component Object Model
<b>DCS</b>	Distributed Control System
<b>DD</b>	Device Description
<b>DDE</b>	Dynamic Data Exchange
<b>DDL</b>	Device Description Language
<b>DE</b>	Digitally Enhanced
<b>DIN</b>	Deutsches Institut für Normung
<b>DLL</b>	Dynamic Link Library
<b>DMZ</b>	De-militarized Zone
<b>DNA</b>	Microsoft's Distributed iNternet Architecture
<b>DP</b>	Differential Pressure
<b>DRAM</b>	Dynamic Random Access Memory
<b>DRP</b>	Distribution Resource Planning
<b>DSD</b>	Direct Store Delivery
<b>DSP</b>	Digital Signal Processor or Digital Signal Processing
<b>DTD</b>	Document Type Definition
<b>DVD</b>	Digital Versatile Disc
<b>E-Business</b>	Electronic On-line Business
<b>E-Commerce</b>	Electronic On-line Commerce
<b>EAI</b>	Enterprise Application Integration
<b>EAM</b>	Enterprise Asset Management
<b>EAS</b>	Electronic Article Surveillance
<b>EC</b>	Electronic Commerce
<b>ECR</b>	Efficient Consumer Response
<b>eCRM</b>	Electronic Customer Relationship Management
<b>EDI</b>	Electronic Data Interchange
<b>EDM</b>	Electronic Data Management or Electrical Discharge Machine

---

<b>GTO</b>	Gate Turn Off Thyristor
<b>GUI</b>	Graphical User Interface
<b>HAL</b>	Hardware Abstraction Layer
<b>HART</b>	Highway Addressable Remote Transducer
<b>HAZOP</b>	Hazard & Operability
<b>HDLC</b>	High Level Data Link Control
<b>HDTV</b>	High Definition Television
<b>HMI</b>	Human Machine Interface
<b>HP</b>	Horsepower
<b>HPI</b>	Hydrocarbon Processing Industry
<b>HTTP</b>	HyperText Transport Protocol (Internet)
<b>HVAC</b>	Heating, Ventilating, Air Conditioning
<b>H/W</b>	Hardware
<b>I/O</b>	Input/Output
<b>IA</b>	Industrial Automation
<b>IC</b>	Integrated Circuit
<b>IEC</b>	International Electrotechnical Commission
<b>IEEE</b>	Institute for Electrical & Electronic Engineers
<b>IFP</b>	Intelligent Front Panel
<b>IGBT</b>	Insulated Gate Bipolar Transistor
<b>Internet</b>	Worldwide network of loosely connected and diverse computers
<b>Intranet</b>	Internet implementation within an enterprise
<b>IP</b>	Internet Protocol
<b>IPO</b>	Initial Public Offer
<b>IR</b>	Infrared
<b>ISA</b>	International Society for Measurement & Control
<b>IR</b>	Independent Representative
<b>ISA</b>	Instrument Society of America
<b>ISFET</b>	Ion Sensitive Field Effect Transistor
<b>ISO</b>	International Standards Organization
<b>ISP</b>	InterOperable Systems Project
<b>ISV</b>	Independent Software Vendor
<b>IT</b>	Information Technology
<b>JAVA</b>	Object-Oriented programming language for Internet
<b>JCAF</b>	Java Control & Automation Framework
<b>JEIDA</b>	Japan Electric Industry Development Association
<b>JEIF</b>	Japan Electrical Industrial Federation
<b>JEMA</b>	Japan Electrical Manufacturers' Association
<b>JEMIMA</b>	Japan Electrical Measuring Instruments Manufacturers' Association
<b>JISC</b>	Japanese Industrial Standards Committee

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NN	Neural Networks
NTE	Microsoft's Windows NT Embedded Operating System
NTE	National Transportation Exchange
NURBS	Non-Uniform Rational B Splines
OA	Office Automation
OCX	OLE Custom Control
ODBC	Open Database Connectivity
OEM	Original Equipment Manufacturer
OI	Operator Interface
OLE	Object Linking and Embedding
OMAC	Open Modular Architecture Control
OMG	Object Management Group
OMS	On-line Management System
OO	Object-oriented (Analysis, Design or Programming)
OPC	OLE for Process Control
OS	Operating System
OSF	Open Software Foundation
OSHA	Occupational Safety & Health Administration
OCS	Open Control Systems
ORP	Oxygen Reduction Potential
OSF	Open Software Foundation
OSI	Open Systems Interconnect
PAS	Process Automation System
PC	Personal Computer
PCS	Process Control System
PD	Positive Displacement
PDM	Project Data Management
P&ID	Process and Instrumentation Diagram
PES	Process Electrochemical Systems
PID	Proportional Integral Derivative
PIM	Plant Information Management
PIMS	Process Information Management System
PIP	Partner Interface Process
PLC	Programmable Logic Controller
PM&C	Process Monitoring & Control
PMD	Programmable Message Display
POSIX	Portable Operating System Interface
PPP	Point-to-Point Protocol
Profibus	Process Fieldbus
PSI	Pounds per Square Inch

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<b>SIS</b>	Short-Interval-Scheduling
<b>SKU</b>	Stock Keeping Units
<b>SLA</b>	Service Level Agreement
<b>SLC</b>	Single Loop Controller
<b>SLDC</b>	Single Loop Digital Control
<b>SLIP</b>	Serial Line IP
<b>SmallTalk</b>	Object Oriented Programming Language
<b>SMP</b>	Symmetrical Multiprocessing
<b>SMT</b>	Surface Mount Technology
<b>SoftLogic</b>	PC-based Logic Control
<b>SOP</b>	Standard Operation Procedure
<b>SP50</b>	Standards & Practice Committee No. 50 (ISA)
<b>SPC</b>	Statistical Process Control
<b>SQC</b>	Statistical Quality Control
<b>SQL</b>	Structured Query Language
<b>SSH</b>	Secure Shell
<b>SSL</b>	Secure Socket Layer
<b>S/W</b>	Software
<b>TBP</b>	Transaction Based Payments
<b>T/C</b>	Thermocouple
<b>TCO</b>	Total Cost of Ownership
<b>TCP/IP</b>	Transmission Control Protocol / Internet Protocol
<b>TCT</b>	Total Cycle Time
<b>TIE</b>	Technical Information Exchange
<b>TL</b>	Truckload
<b>TM</b>	Transportation Management
<b>TMS</b>	Transportation Management System
<b>TOP</b>	Technical and Office Protocol
<b>TQC</b>	Total Quality Control
<b>TQM</b>	Total Quality Management
<b>TUV</b>	Technischer Uberwackungs Verin (Technical Inspection Association)
<b>TVO</b>	Total Value of Ownership
<b>UEM</b>	Unified Enterprise Management
<b>UL</b>	Underwriters Laboratories
<b>UML</b>	Unified Modeling Language
<b>UPC</b>	Uniform Product Code
<b>URL</b>	Uniform Resource Locator (Internet)
<b>USB</b>	Universal Serial Bus
<b>UV</b>	Ultraviolet
<b>VAN</b>	Value Added Network

<b>USP</b>	United States Pharmacopeia
<b>VAR</b>	Value Added Reseller
<b>VAS</b>	Value Added Services
<b>VBX</b>	Visual Basic custom control
<b>VCI</b>	Value Chain Initiative
<b>VDU</b>	Visual Display Unit
<b>VF</b>	Vacuum Fluorescent
<b>VFD</b>	Variable Frequency Drive
<b>VICS</b>	Voluntary Inter-Industry Commerce Standard Committee
<b>VLSI</b>	Very Large Scale Integration
<b>VMI</b>	Vendor Managed Inventory
<b>VoIP</b>	Voice Over Internet Protocol
<b>VPN</b>	Virtual Private Network
<b>VSD</b>	Variable Speed Drive
<b>VVI</b>	Variable Voltage Inverter
<b>VVVF</b>	Variable Voltage, Variable Frequency
<b>WAH</b>	Web Application Hosting
<b>WABI</b>	Windows Application Binary Interface
<b>WAN</b>	Wide Area Network
<b>WIP</b>	Work In Process
<b>WM</b>	Warehouse Management
<b>WMS</b>	Warehouse Management System
<b>WOSA</b>	Windows Open Systems Architecture
<b>WWW</b>	World Wide Web (Internet)
<b>XML</b>	Extensible Markup Language
<b>Y2K</b>	Year 2000