Markets

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$1.4 trillion Industrial IoT and Remote O&M Market by 2030

- Industrial IoT or IIoT is growing faster than IoT generally and will eventually be a much larger market. It will also be a catalyst for major industry changes which Accenture predicts will add $14 trillion to the global economy in 2030. One near term achievement is asset management but longer term IIoT will transform the process industries and allow individuals to focus on problem solving and collaboration as machines replace some of their prior duties. It will result in better products produced at lower cost. It will be a catalyst for more rapid development of new products. This includes products made by the process industries and products used in the process industries.
- One of the most important opportunities is remote monitoring along with remote operation and maintenance support. Remote monitoring centers have been set up by suppliers and end users such as power plants. Initially they were used primarily to warn the operator of problems such as vibration of rotating parts or temperature increases due to lube oil problems. However, the development of inexpensive sensors and sophisticated software, remote operations and maintenance management will not only be possible but will result in better outcomes.

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Market, cont.

- Software platforms which allow systems to communicate with each other will allow collaborative remote monitoring. System, component and consumable suppliers will collaborate with the operators and subject matter experts to solve problems and improve operations with the introduction of innovative solutions.
- The resultant revenues accruing from this development will be $1.4 trillion by 2030. This includes $590 billion of new revenues and $870 billion of revenues which would have otherwise been generated by traditional market routes.

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2030 Industrial IoT and Remote O&M Market

2030 Industrial IoT and Remote O&M Market - $ billions								
	Market Absent IIOT			Market with IIoT Impact				
Component	New	Repair /Replace	Total	No Effect	New Route	Addi-tional Revenue	Total	IIoT
Valves								
Pumps								
Automation								
Combust & Steam								
Heat Transfer								
Conveying								
Separation and Reaction								
Other								
Total								

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Market by Industry

Industry	Onsite	Remote O&M	Total $ billions
Total			
Chemical			
Electronics			
transportation			
Food			
Metals			
Mining			
Oil and Gas			
Other Industries			
Pharmaceutical			
Power			
Pulp & Paper			
Refinery			
Stone			
Wastewater			
Water			

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Chemical Industry - $ billions

World Region	2016	2018	2020	2022	2024	2026	2028	2030
Total								
Africa								
CIS								
East Asia								
Eastern Europe								
Middle East								
NAFTA								
South & Central America								
West Asia								
Western Europe								

IIoT and Remote O&M chemical industry revenues will grow from $9 billion in 2016 to $15 billion in 2020. By 2030 the revenues will be $56 billion. In 2020 East Asia will generate IIoT chemical industry revenues of $4.8 billion up from $2.8 billion in 2016

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Measurement Categories

Measurement Categories	Examples
Function	Analysis, extraction, integration, display, services, consumables, accessories
Medium	Ambient air and water, process liquids and gases, solids, oil, injection chemicals
Properties Measured	Physical, chemical, electrical, other
Measurement Parameters	Count, weight, volume, temperature, pressure, contaminants, viscosity
Operating Principles	Chemical, electrochemical, light, opacity
Mode of Use	Continuous, hand held, laboratory, process

Most remote monitoring today is vibration monitoring of rotating parts and lube oil pressure. There is a huge potential to monitor and utilize the other measurement data

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Instrumentation Market Size by Medium Measured and Industry

Instrumentation Market Size by Medium Measured						
Fuel Source	**Weather**	**Water**	**Air**	**Process Liquids**	**Process Gases**	**Solids**
Coal	S	H	H	M	M	H
Nuclear	S	H	M	H	H	M
Gas	S	M	H	S	S	S
Solar	L	S	S	S	S	S
Wind	L	S	L	S	S	S
Biomass	S	S	L	S	S	L
Geothermal	S	M	L	H	H	S
Hydro	S	H	S	S	S	S

L= large, M= medium, S= small

Component Monitoring in Power Plants

- **Component Monitoring**
- Condition monitoring of components is well established for lubrication systems for turbines, compressors, etc. The growth opportunities are in measuring not only the health but also the operational information of valves, pumps, filters, separators and other components. Mann + Hummel recognizes this opportunity and has just invested in a large filtration IoT research center in Singapore. Pentair, Flowserve and other pump and valve suppliers are rapidly strengthening their component monitoring capabilities.
- **Digital Data Generation at the Plant**
- GE says that coal-fired power plants could be made approximately 4 percent more efficient with 2.5 percent improvement in efficiencies coming from turbine and boiler upgrades, and 1.5 percent coming from software improvements. The analysis also found that applying all potential upgrades to coal-fired power plants can remove 900 million metric tons of CO_2 (11 percent of total coal power emissions) - more than the annual CO_2 output of the United Kingdom and France combined.
- McIlvaine has conducted nine hours of webinars for PacifiCorp with presentations by GE, Emerson, Siemens and others which pointed the way to large savings with combustion optimization. The reduction in NO_x emissions was particularly significant.
- **Software Programs**
- The software programs include partnerships between power plant system suppliers and specialized software providers. GE says Predix will enable GE to lead the next generation of industrial progress, through improved manufacturing processes and digitally manufactured products, transforming GE into a stronger and more valuable company. GE believes its digital business will grow GE's software and analytics enterprise from $6 billion in 2015 to a top 10 software company by 2020. GE has purchased NEUCO who has developed neural networks to control not only the operation of the furnace but also components such as soot blowers.
- General software participants include large companies such as Intel with its Wind River subsidiary and specialist companies such as OSIsoft and SoftDEL.

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Remote Monitoring

- The large gas turbine suppliers have remote monitoring centers which primarily track the health of rotating parts. This is frequently part of the warrantee program. However, companies such as MHPS are branching out to monitor more of the plant's components. MHPS just opened a remote monitoring center in the Philippines which is monitoring coal-fired power plants. The service center can also provide assistance to power plants not built by MHPS. In addition to its data analysis capabilities, the center can also manage maintenance equipment and dispatch staff in emergency situations. It will, in addition, serve as a training hub for technicians. Every year, around 200 individuals will be picked from both in and outside the company to transfer technical expertise on maintenance and management.
- There is a huge potential for companies such as MHPS and GE to work with other suppliers and incorporate hundreds of individual remote monitoring programs. For example, Nalco operates an around the clock monitoring center on water quality. If companies such as Mann + Hummel can operate filter monitoring centers and, if all the results are integrated for analysis and action, it will greatly improve the support for the operators.
- There is a big potential for interconnection of facilities in large utility organizations. McIlvaine has been involved with a program for Berkshire Hathaway Energy.
- http://home.mcilvainecompany.com/index.php/decisions/28-energy/1185-4s01
- Duke Power has developed central systems which can for example monitor all the pumps at its various stations. However, it is shifting away from the traditional centralized proprietary systems and evolving to support distributed intelligence, interoperability and IoT. Efforts to develop its smart grid have resulted in the enablement of these concepts through what the industry calls OpenFMB (Open Field Message Bus).

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Remote O&M, Data Analytics and Subject Matter Experts

- **Third Party Support for Power Plant Operations and Maintenance**
- Third party operation and maintenance represents the biggest revenue opportunity for IoT in the power industry.
- GE Energy is one of the world's largest third party providers of plant Operation and Maintenance services, currently with more than 16,000 MW at 60 sites in 17 countries under O&M contract. Global resources combined with over 20 years of O&M experience, enable GE to provide complete plant services across the turbine island and balance of plant—for both GE and non-GE equipment.
- Siemens, MHPS, IHI and other turbine suppliers also offer similar services. There are a number of companies specializing in O&M including large companies such as Wood and smaller companies such as Ethos Energy and Proenergy. Uniper and India Power have formed a joint venture to support operations and maintenance at Indian power plants.
- **Data Analytics and Subject Matter Experts**
- The generation of large amounts of data is not of value unless it is properly analyzed for action. XLMPR recommends hybrid data analytics marrying the experience based models with ones based on physics and data. The IoT greatly increases the capability for database models but this data needs to be molded by experience. Subject matter experts are needed to provide the niche expertise in each of thousands of areas. The pool of recently retired people can be tapped for their unique combination of knowledge and availability for short engagements.

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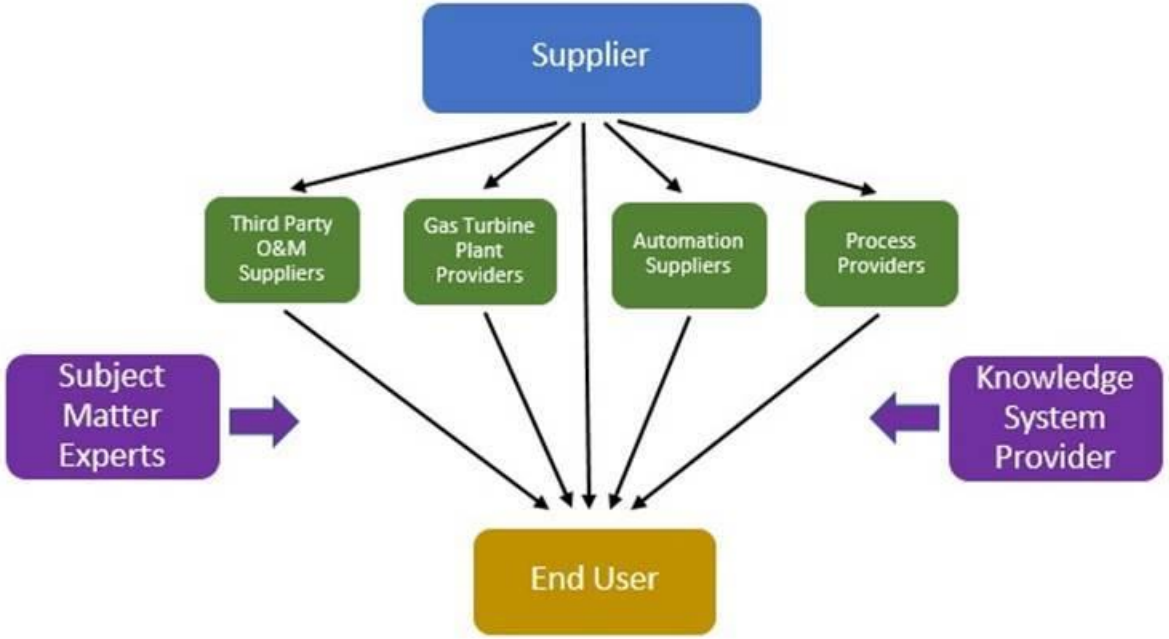
Gas Turbine and Reciprocating Engine IIoT and Remote Markets for Components

There is a new route to market with higher revenues for component suppliers who can expand services subject matter expert revenues by working with five different entities.
The global service, replace, and repair opportunity in GTCC is

- Gas turbines and all components $100 billion/yr
- Liquid cartridge $400 million/yr
- Pumps $1 billion/yr
- Valves $1.5 billion/yr
- Air filters $700 million/yr



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