



Mindteck Insight

Mpowering Performance

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Dear Colleague,

I am happy to reach out to you with the first edition of Mindteck Insight in partnership with Frost & Sullivan. This edition, dedicated to analytical instruments, discusses the expanding possibilities of embedded systems applications in this domain. I am sure that our research, content, and case studies will offer you a deeper understanding of the emerging trends in the analytical instruments market.

Customers in the \$2.4 billion global analyzers market today are demanding efficient and economic product variants, and exceptional customer service. Delivering these profitably in an intensely competitive market is the challenge that players in this market face. Mindteck Insight captures the role of embedded systems in analytical instruments and how manufacturers stand to gain from outsourcing embedded systems development.

The case studies presented in this edition provide rich insights into the possibilities in outsourcing embedded systems development. These case studies also demonstrate how Mindteck has helped global analytical instrument manufacturers in their efforts to bring to market state-of-the-art instruments.

In this edition, we catch up with Shankar Velayudhan, Group CTO, Mindteck, speaking on the range of services offered by Mindteck in the embedded systems development space.

Mindteck Insight welcomes you to share your thoughts on the role played by embedded systems in the analytical instruments domain.

Do look forward to our next issue. And, let us know what you think.

Best wishes,

PA Ananthanarayanan
Group Chief Executive Officer

ANALYTICAL INSTRUMENTS: OPENING NEW VISTAS

THE ANALYTICAL INSTRUMENTS LANDSCAPE

Innovation, efficiency, and quality represent the defining mantras of 21st century industry. And, process industry is no exception. By providing crucial information on the chemical composition of process streams, analytical instruments have emerged as critical success factors in the process industry. The number of process analyzers has increased since the beginning of this decade, leading to improvements in production efficiency, product quality, emission- and effluent-monitoring, and finally, increased profitability. Electronics plays a significant role in present day process analyzers. Most analyzers are standardized, and hence, add-on features such as interconnectivity with other process analyzers and operability with handheld devices and laptops are gaining wider acceptance. The application of analytical instruments spreads across

different process industries. The end-user sectors range from established segments such as Oil and gas, Chemical and petrochemicals, and Water and wastewater to sunrise segments such as Pharma and biotech.

Broadly, analytical instruments used in process industries fall into four categories. (Table 1)

Table 1: Analytical Instrument Product Groups

Chromatographs	Undertake chromatographic separation (i.e., a broad range of physical methods employed to separate and analyze complex mixtures)
Spectrometers	Study absorbency (i.e., the amount of light being absorbed by the sample or the transmittance) and the amount of light passing through the sample
Gas Analyzers	Analyze several compounds found in process gas streams
Liquid Analyzers	Measure the composition of liquid samples, an optimal application being water contamination testing and analysis

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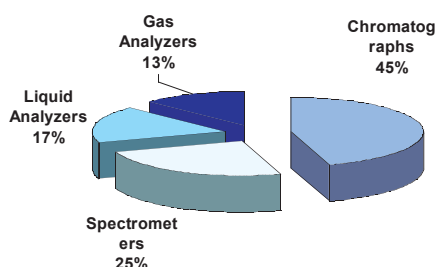
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GLOBAL SCENARIO

The world analytical instrumentation market in 2005 was worth \$2.38 billion. The market is expected to grow at a CAGR of 4.3% over the next five years to touch \$2.94 billion in 2010. In 2005, North America, with 44.5% accounted for the largest share of the world analytical instrumentation market. It was followed by Europe with 29.5%, Asia Pacific with 18.5% and the rest of the world accounting for 7.4%. Process chromatographs represented the largest segment in 2005 with 45.2% share of the market followed by spectrometers with 24.7%, liquid analyzers with 17.2% and gas analyzers with 12.9%, according to S.Sabarinath, Senior Research Analyst (Industrial Technologies Practice), Frost & Sullivan, India. (Table 2)

Table 2: Product-Wise Market Shares



CHROMATOGRAPHS:

The process chromatographs market was estimated at \$1075 million in 2005 and is forecast to grow at a CAGR of 6.9% for the period 2005 to 2010. In

the process chromatographs market, liquid chromatographs account for the largest share and are followed by gas and ion chromatographs. The chromatographs market has remained stable for a decade and is likely to remain so in future. While gas chromatographs have declined recently and are expected to decline in future as well, liquid and ion chromatographs are registering growth.

SPECTROMETERS: In the \$588 million spectrometers market, the Infrared type dominates the market, followed by Ultraviolet and Mass spectrometers with smaller shares. The spectrometers market growth is not uniform globally. While some regions exhibit encouraging growth, a few regions show little or no growth. Another interesting trend in this market is the growing use of substitute instruments such as calorimeter in place of infrared spectrophotometer and ion analyzer (amperometric analyzer) as an alternative to the ultraviolet spectrophotometer. The spectrometers market is forecast to grow at a CAGR of 3.8% for the period 2005 to 2010.

GAS ANALYZERS: Gas analyzers find application in gas separation, chemicals, automotive, semiconductor fabrication and power plants. In the \$307 million process gas analyzers market, electrochemical and magnetic gas analyzers make up about one half of the market followed by chemiluminescence and thermal conductivity gas analyzers and flame ionization detectors. With a modest growth rate of 3.6%, the gas analyzers market has been passing through a slowdown phase. The near-maturity of the market is one reason for slow growth. Falling prices is another trend that has impacted this market like every other near-mature market. Product improvements leading to cheaper production costs and inflationary trends dampened prices.

Table 3: Major Products and Industry Participants

Product Groups	Product Types	Industry Participants
Chromatographs	Liquid Chromatographs Gas Chromatographs Ion Chromatographs	Agilent Tech, Varian Inc, ABB Analytics, Rosemount Analytical, Waters Corp., Dionex Corp, Thermo Onix, Siemens Energy & Automation, Galvanic Applied Sciences
Spectrometers	Infrared Spectrometers Ultraviolet Spectrometers Mass Spectrometers	Agilent Tech, Varian Inc., Shimadzu Corp, PerkinElmer Inc., Hach, JEOL, Thermo, Jasco Inc.
Gas Analyzers (GA)	Electrochemical GA Magnetic GA Chemiluminescence GA Thermal Conductivity GA Flame Ionization Detectors	PerkinElmer Inc., ABB Analytics, Rosemount Analytical, Thermo Finnigan, Siemens Energy & Automation, Illinois Instruments, Nova Analytical Systems
Liquid Analyzers (LA)	Conductivity LA Dissolved Oxygen LA Turbidity Analyzers Titro Analyzers TOC Analyzers Calorimeters Refractometers	Teledyne, ABB Analytics, Rosemount Analytical, Honeywell, Wedgwood Technologies, Yokogawa Corp.

LIQUID ANALYZERS: Process analyzers find application in wastewater, ultrapure water, potable water, product contamination, and effluent monitoring. The market for process liquid analyzers is estimated to be \$408 million in 2005. In terms of revenue share, conductivity and dissolved oxygen analyzers account for about one half of the market. Turbidity analyzers, titro analyzers, total organic carbon analyzers, calorimeters and refractometers comprise the rest of the market. Market growth was subdued, following the saturation of western markets. Also, the CAGR for 2005 to 2010 is expected to be 4.2%.

The analytical instrumentation industry is organized into large and niche players. The large players are MNCs with wider product portfolios catering to a broad range of end user industries. The niche players are smaller companies engaging more focused customer segments with niche products. (Table 3)

END USER SEGMENTS

Analytical instruments find application in every process industry. The major end user segments include Oil and gas, Chemicals and petrochemical, Pharma and biotech, and Water treatment. In the analyzers market, Oil and gas, and Chemicals and petrochemicals account for the largest share among the end user segments. Sunrise segments Pharma and biotech hold future growth potentials. The leading end user segments for each major analytical instrument product group are listed in (Table 4)

In the chromatographs market, the share of Pharma and biotech is increasing at the cost of Oil and gas, and Chemicals and petrochemicals. Meanwhile, in the spectrometers market, the share of Chemicals and petrochemicals, and Pharma and biotech is rising

Table 4: End User Segments (Ranked on the basis of segments' shares)

Chromatographs	Chemicals, Petrochemicals, Oil & gas, Pharmaceuticals, Biotech
Spectrometers	Chemicals, Petrochemicals, Oil & gas, Pharmaceuticals, Biotech
Gas Analyzers	Oil & gas, Chemicals, Pharmaceuticals
Liquid Analyzers	Water and waste water, Ultra pure water, Chemical processing, Semiconductor

compared to the other markets. Semiconductors and others (e.g., power segment) are losing share to the water treatment and chemical processing segments in the liquid analyzers market. In the gas analyzers market, the chemicals segment is making gains compared to the other markets.

MARKET AND TECHNOLOGY TRENDS

The market growth in western economies has been relatively slower and large corporates are actively contemplating inorganic growth options. In the face of limited market expansions, consolidation is expected to be the natural next step. Analytical instrument manufacturers are increasingly acquiring small companies with specialized capabilities. This is expected to give them the requisite edge through wider product portfolios and access to newer markets.

The quantum of data processing has increased as companies strive to attain appreciable quality levels. With increase in data volumes, maintaining these data and converting them into useful information have become critically important. Companies offering data management system services alongside analytical instruments are likely to succeed in this mature market. The acquisition of data management companies by large analytical instrument manufacturers is a distinct trend in the market. With associated electronics and communication protocols becoming increasingly integral to process analytical instruments, these acquisitions carry strategic significance.

The future belongs to companies offering instruments that are reliable, offer value for money and responsive service, and possess superior technology for regulatory compliance.

ANALYTICAL INSTRUMENTS IN A NEW WORLD ORDER

The major driver of the global analytical instruments market is the growing demand from emerging markets such as China, India, Russia, Eastern Europe, ASEAN and Latin America. The increased economic activity in these regions and shift of manufacturing bases from developed to developing regions, led to significant investments in green field projects and capacity expansions. This increased the demand for process analyzers. The new regulations on safety, environmental issues and quality control in different industries have increased process analyzer

usage. Also, activist groups such as Environmental Protection Agency created awareness on the use of regulation-compliant products. These factors further contributed to the demand for analytical instruments. The increased competition spurred price falls, technology enhancements and product differentiations, thus assisting market growth. The drive towards enhanced productivity hastened process automation, and major end user industries felt the need to crunch analyses time. With a view to minimize manual intervention and increase accuracy levels, key end user segments are resorting to process analyzers with digital capabilities for real time data gathering and process control. Driving demand in the civil utilities segment is the growing need for potable water and better waste water treatment. **(Table 5)**

Table 5: Impact of Market Drivers, 2004-2010

Drivers	Short Term (1-3 years)	Long Term (4-7 Years)
Increased demand from emerging markets	Medium	High
New regulatory edicts in various countries	Medium/High	High
Competition among suppliers	Medium	Medium/High
Demand for water / waste water treatment	Medium/High	High
Continuous improvement in analysis time	Medium/High	High

In the developed world, the analytical instruments market is in its mature stage, characterized by nominal growth rates in the end user segments. There are fewer green field projects today than there were a few years ago. Besides, the present generation analyzers have longer product lives, and consequently, smaller replacement markets. On the other hand, the fast growing developing economies have been slow to evolve from low cost product markets into high end product markets. Meanwhile, emerging markets turned extremely competitive typified by larger product pools for customers to pick and choose from and reduced profit margins for vendors. This being the case, the analytical instruments market finds itself facing significant challenges such as the need to offer faster, cheaper, and reliable products. There is market demand to continuously innovate and offer customers numerous product variants closely matching their aspirations. Moreover, customer support and effective distribution channels have become decisive factors in sustaining market shares in the highly competitive and mature market. More importantly, process analyzer industry players need to maintain profitable cost structures simply to stay in business. **(Table 6)**

EMBEDDED SYSTEMS IN ANALYTICAL INSTRUMENTS

The analytical instruments industry has been reinventing itself to meet the challenges of regulatory compliance, and increased automation and process speeds. Besides, customers are increasingly demanding and service level agreements (SLAs) have become the norm in the analytical instruments market, guaranteeing commitments. This brings intense pressure on instrument manufacturers to consistently deliver more accurate, reliable and effective products.

Table 6: Impact of Industry Challenges, 2004-2010

Challenges	Short Term (1-3 years)	Long Term (4-7 Years)
Effective and economic product variants	Medium/High	Medium
Adequate customer service and support	Medium/High	Medium
Having an effective distribution channel	Medium	Medium/High
Maintaining a profitable cost structure	Medium	High
Intense competition in developing countries	Low/Medium	Medium

Analytical instruments are prime sources of information for critical decisioning in process industries. Hence these instruments need to be reliable and robust, collecting accurate data in real time and making data available in usable formats. Against this backdrop, embedded systems have risen to prominence as essential components in analytical instruments, driving all their functionalities.

Embedded systems provide the instrument manufacturer the technology edge to address the requirements of users and stay competitive. These systems prepare the manufacturers to innovate and offer value addition at minimal cost, thus helping them to pull away from competitors. Realizing these positive business fallouts, manufacturers have been incorporating embedded systems in every major product group of the analytical instruments family.

The analytical instruments market has become fiercely competitive and manufacturers are trying hard for faster rollouts of product variants. Apart from product improvements, better customer support and lower cost are expected to be pivotal in sustaining profitability. Globally, instrument manufacturers have started embracing the core competence business model, which underscores the need for a core activity focus and reduced time to market. To implement this business model, some critical activities are being transferred to strategic partners with demonstrated capabilities in providing optimal solutions.

Table 7: Embedded Systems Design and Development Services

Product Engineering	End-to-end solution including design, development and implementation; packaging and commercialization support
Embedded Software Development	Designing software architectures for embedded systems; developing embedded applications, device drivers and board support packages
Electronics Design	Circuit design, PCB design, prototype assembly, board bring up, firmware development and integration
Verification and Validation Services	Functional testing of system, developing test cases, interoperability testing and automated test environments

In order to remain competitive and profitable, manufacturers have identified embedded systems design and development as a key area for strategic partnerships with domain experts. This provides manufacturers with a truly unique value proposition meshing time and cost savings, and access to contemporary technology for their products, plus seasoned subject experts. (Table 7)

Manufacturers are also judicious in choosing their partners for embedded systems as it is a crucially important activity area. The success of the business model is predicated on the choice of partners with the right experience and domain knowledge to provide optimal solutions.

THE RIGHT-FIT PARTNER FOR EMBEDDED SYSTEMS DEVELOPMENT

Identifying the right partner is the key to success in outsourced embedded systems development. Key considerations in choosing the right partner:

- o The manufacturer needs to be endowed with long term vision and work towards a strategic value-adding partnership with the solution provider.
- o The embedded systems solution provider should reciprocate and acknowledge the relationship as a true partnership.
- o The manufacturer should evaluate the potential partner's expertise in domain and core technologies, track record in project execution and delivery models.
- o In addition to quality certifications and testimonials, the manufacturer should look for matured program governance and comprehensive engagement models.
- o Finally, by visiting the delivery centers and interfacing with technical staff, the manufacturer can have a firsthand assessment of facilities, competencies, people, and security measures.

DOMAIN VISION: EMBEDDED SYSTEMS

EMBEDDED SYSTEMS PROVIDERS: UNDERPINNING REAL, SUSTAINABLE, ENTERPRISE-WIDE PERFORMANCE IMPROVEMENTS

Outsourcing is a critical business strategy for any forward-thinking enterprise. Broadly, there exist two divergent outlooks on outsourcing: one, underlining core competencies; the other, stressing on cost advantage. Taking the outsourcing engagement beyond mere cost arbitrage, today's partnership model between embedded systems providers and analytical instrument manufacturers architects strategic value for both participants.

In a market space besieged by ever-increasing competition, shrinking product lifecycles and narrowing differentiations, instrument manufacturers should decide on swifter product variant rollouts, provide expert customer support and contain costs noticeably. Embedded systems provide instrument manufacturers the innovative edge, address market requirements and help them stay competitive. It takes a global embedded systems provider to deliver the strong blend of innovation in embedded systems, accelerated time-to-market and cost advantages. It has become imperative for analytical instrument manufacturers to seek out embedded systems providers with depth of competence and who are high on the innovation trajectory. (Table 8)

Table 8: DNA of a Global Embedded Systems Provider

Dominant features	Outcomes
Transformational outsourcing	Real, sustainable, enterprise-wide performance improvements
Thought leadership	Innovation; intense customer-focus; quicker decisions and response times
Domain expertise and technical skills	On-demand intellectual capital availability; faster innovation-diffusion
Global delivery	Remarkable cost competitiveness by migrating activities to multiple, low cost geographies
Quality, not just certifications	Increased success probability resulting from formal and comprehensive customer engagement models complete with certifications and assessments
Sensitized processes	Improved focus, receptiveness, changeability and flexibility

Leveraging such symbiotic relationships with embedded systems providers, analytical instrument companies can dramatically transform their operating model and create value while drastically lowering costs.

MINDTECK: TRUSTED EMBEDDED SYSTEMS PARTNER

Embedded systems development is a core area of expertise at Mindteck, offering comprehensive solutions purposed to answer every critical challenge in the customer's business ecosystem. Mindteck's customer value creation and enhancement strategy, being the focal point, guarantees success in every case.

Real, sustainable, enterprise-wide performance improvements

Analytical instrument manufacturers point to embedded systems design and development as fundamental building blocks at the heart of value creation and cost competitiveness. Manufacturers, today, proactively partner with embedded systems design providers in launching feature-rich product variants at lowered cost structures. And, embedded systems are contributing ever-increasingly towards developing analytical instruments and expanding their markets. Mindteck helps analytical instrument manufacturers reap real, sustainable, enterprise-wide performance improvements. Our partnership with instrument manufacturers has a purpose beyond simple cost savings. Our engagement models decidedly map to the customer's business strategy. Be it steering growth through product and value differentiations, entering blue ocean, uncontested market spaces, responding to competition, coping with shifting customer needs and changing market dynamics, or managing inadequacies in organizational skills, our solutions are designed to spur business innovation, value and profitable growth. Mindteck, in effect, acts as the extended engineering arm of the analytical instruments manufacturer.

Innovation; intense customer-focus; quicker decisions and response times

Mindteck's leadership team brings decades of experience in management, technology, relationships and outsourcing, plus an exceptional track record. Our subject experts have specialized, in-depth understanding in diverse spheres of knowledge and are supported by

best-in-class technologies, people, methodologies, skills and practices. Today Mindteck engages several global product companies providing core embedded systems development services. We work on engagements where our customers undertake the highest level of product creation while we turn the concept into an actual product. Customer value creation, conflict of interest and intellectual property protection are critical issues demanding elaborate planning. Both sides need to work closely from day 1 getting relationships right. Mindteck, a thoroughbred, pure services player, does not compete with product companies. Instead, its work-for-hire model unequivocally acknowledges customers as owners of the products it develops for them. Our team acutely understands customer expectations, ensuring real-time responses, strength and purposiveness.

On-demand intellectual capital availability; faster innovation-diffusion

Mindteck's analytical instrument Center of Excellence (CoE) offers added domain and technology support to its teams deployed on diverse customer engagements. Even as the CoE engine consistently drives customer value creation and enhancements, we are toying with innovative ways of hardwiring the CoE with customer R&D, enabling faster diffusion of innovation. Our twin-focus on mastering innovative technologies and understanding the customers' business needs enables us to address the development projects from the perspective of both technology and business. Our domain expertise comes from years of experience in building embedded systems for several analytical instruments.

Mass spectrometers

Drawing on profound understandings of various ionization techniques in mass spectrometers (electron impact, chemical ionization, atmospheric pressure, electrospray), ESI (TurboIonSpray and NanoSpray) and MALDI, we undertake software development, electronics design and reengineering for mass analyzers. This includes magnetic sector, quadrupole, single quadrupole, triple quadrupole, ion trap 3-D, ion trap-linear, time of flight (TOF), and Fourier transform MS.

Chromatographs

We develop drivers for auto sampler, solvent processing (solvent management, method development and high pressure mixing) and detectors; embedded software for acquiring and porting data. This includes ultraviolet, refractive index, fluorescence and electrochemical detections, and reporting systems.

Gas analyzers

We have rich expertise in developing front end applications (spectral analysis enabling monitoring of multiple components and GUI based calibration), multi-channel detection and analysis; specific drivers for control valves (valve box); integrating with standard protocols (CANbus & Profibus).

Liquid analyzers

Also, we build applications for quantitative measurement components, pH determination and monitoring; drivers for auto samplers, PC-based software for spectral analysis and detection; front end applications for instrument configuration and results display.

Mindteck has expertise in a wide range of processors, RTOS, protocols and development platforms, including:

- o Processors: INTEL, ARM, Freescale, Atmel, Analog Devices, TI, MIPS, Philips, Microchips
- o RTOS: VxWorks, pSOS, Embedded Linux, Windows CE, OSE, Nucleus, QNX, proprietary OS
- o Protocols: Modbus, CANbus, Profibus, I2C, USB, ZigBee, Bluetooth, Wi-Fi
- o Development platforms: .Net, Java EE

Cross-pollinating knowledge, experience and innovation, Mindteck gives you a clear advantage.

Global delivery; multi-site development centers

Mindteck's global delivery model provides value and ensures lowest possible total cost of ownership (TCO), harnessing multi-site development centers, access to local talent, proven processes and methodologies. Our state-of-the-art global development centers support enterprise-wide communication and networking, productivity, collaborative software engineering, and distributed project management. All development centers are governed by centrally administered policies. These policies are benchmarked globally for physical and network security, data, project segregation and protection, and business continuity planning.

The decision to move offshore or stay onshore is a critical challenge that every forward-thinking enterprise faces. An offshore development center (ODC) in India is a time-tested approach to successful offshoring. It extends development abilities by assigning cost-effective, scalable, and highly skilled technical resources to support development cycles. Our ODC solutions optimize cost and quality for critical IT initiatives. It takes strategy intersected with leadership and vision to make offshore outsourcing a winning proposition.

Cost competitiveness

Competitive billing rates in offshore destinations are certainly the key drivers of any outsourced engagement. Offshore billing rates¹ are typically 65% lower than onshore rates. Partnering with Mindteck, a typical analytical instrument manufacturing company can save up to 60% of its product engineering costs by outsourcing development efforts to us. Net savings are, in fact, much higher. While Mindteck's offshore billing rates include overheads on infrastructure and other costs, customer's onshore rates include only consultants' billing rates. We have authored a string of success stories in outsourced embedded systems development while instrument manufacturers saved more than 55% of their project execution costs by moving development efforts to us. Besides cost competitiveness, instrument manufacturers made rich value-gains, leveraging our deep domain and technology expertise, managed delivery and operations (resulting in risk-reduction), accelerated time-to-benefit, greater agility in key processes, and enhanced transparency.

¹ The reference to the difference in billing rates is based on approximate figures. Certain premium consulting services are billed at higher rates.

Increased success probability

At Mindteck, quality is a way of life touching every process, interaction and deliverable. It goes beyond simply delivering error-free solutions. We view our processes and methodologies as inherent features that enable us to exceed customer expectations.

Processes at Mindteck are benchmarked against international standards like ISO 9001 and CMM. Mindteck is an ISO 9001:2000, BS7799 certified, and SEI CMM level 4 assessed company. Our quality consciousness is not limited to certification, for quality certifications by themselves do nothing to foster working relationships. We have matured program governance and comprehensive engagement models alongside certifications and assessments to guarantee success. Our project management processes are supported by practices in line with CMM guidelines. Our iterative development approach and incremental release strategy ensure end products' compliance with customer-specifications and on-time deliveries with only pleasant surprises, in every case.

Improved focus, receptiveness, changeability and flexibility

Outsourcing brings greater business agility to every business function through increased focus, receptiveness, changeability and flexibility. These are achieved by processes that perceive and respond rapidly to change, and bulwark the organization with a truly flexible cost structure. Our outsourced software development and electronics design services effectively free the instrument manufacturers' thought leadership to focus on business strategy formulation and core competencies, and less on workaday executions. The result: greater enterprise-wide business agility. Our software development services help to decidedly align key engineering functions with business goals and strategies. They reduce attendant costs and risks while improving overall performance in the outsourced areas.

Enhanced transparency and control

After all, the success of any outsourcing engagement depends largely on having sufficient metrics in place to measure success. Hence, deciding the appropriate metrics to measure performance is a critical first step in every outsourcing engagement. Outsourcing enhances transparency by progressively segregating responsibilities, defining better processes, and shoring up visibility and control. When development services are provided using a for-profit model rather than an in-house cost center, service providers continuously endeavor to exceed performance metrics and contractual SLAs. At Mindteck, we provide a variety of metrics (e.g., defect rates, standards compliance, technical quality, service availability and satisfaction, time-to-acknowledgement, time-to-implement and backlog size, cost/effort efficiency, team utilization, rework levels, etc.) that indicate the performance of an outsourced engagement. Some are project-specific metrics; others apply engagement-wide. Pledged to guarantee total transparency and efficient relationship management, Mindteck has invested heavily in robust processes, tools and methodologies. Our customized portals with information dashboards and collaborative tools provide real-time project status, and support gainful interactions and information-diffusion amongst virtual, multi-geography project teams.

CASE STUDIES

We serve a significant and diverse worldwide clientele. With a 'Customer First' mind-set and persistent efforts to help customers excel, we have scripted many success stories. The proof is in the pudding. Read some of our success stories to know how we deliver quantifiable results.

Our customer, a manufacturer of chemical analysis instruments, sought to partner with an embedded systems provider to outsource product lifecycle development services. The initial goal was to build a common high-level architecture and implementation platform across product lines. A further goal involves building a reusable software resource pool, reducing development and turnaround times on the one hand while minimizing risks on the other.

Mindteck is partnering with this customer to build gas chromatographers and organic carbon analyzers, implement 21 CFR Part 11 compliance, and internationalize products. In this ongoing relationship for over five years, our dedicated development team has been delivering benefits to the customer through exceptional domain and technology expertise, knowledge diffusion, scalability on-demand and efficient resource management. The development team is involved in multiple engagements including end-to-end product development, reengineering and sustenance engineering services.

One such engagement involves developing an application used for configuring, operating and monitoring a product that transfers and collects volatile organic compounds to and from gas chromatographers. The application developed by Mindteck provides easy to use procedures to configure the system and parametric data for the sampler and gas chromatography operations, and store data. The application provides a user friendly GUI to set up method parameters. The operations regulation is performed via the instrument's core and state machine, which in turn uses Modbus to peek and poke an embedded Programmable Interrupt Controller. Controls are in place to monitor, in real-time, the status of ongoing operations by interacting with the instrument's core machine. The output information is provided to the user both in graphical and textual formats. The functioning of the core instrument and peripheral instruments is monitored using diagnostic functions built into the application. All functions performed and subsequent results are logged locally into an XML based file and a centralized MS Access database. Reports can be easily generated from this data, when stored offline. The application incorporates a feature for regulating all operations using a security & audit trail system. The PC based installation of the instrument has an additional feature supporting formatted reporting of logged data. The instrument can be operated directly from a Windows CE based system with an LCD touch screen mounted on the instrument. Optionally, it can be operated from desktop PCs connected to the instrument over LAN in a Windows environment.

Another engagement for the same customer involves developing control applications for organic carbon analyzers (a three-equipment product line for analyzing varied aqueous and solid samples). Mindteck is building a feature rich application for this product line with user-friendly controls to

set up various parametric data for the instrument, sampler, detectors and operations, and store data. The operations regulation is performed via the instrument's core and state machine. Controls have been built to monitor, in real-time, the status of ongoing operations by interacting with the instrument's core machine. The output information is provided to the user both in graphical and textual formats through online printing, and exported to preformatted text files. The core and peripheral instruments (like auto-samplers) are regulated and monitored using built-in diagnostic functions. Functions are carried out and subsequent results stored locally into serialized file systems and a centralized MS Access database. The application incorporates features regulating all operations using a security and audit trail system (through functions either integrated with the device version of the software) or using a standalone PC based application. Additionally, the instrument's PC application allows data export to and import from external databanks such as Laboratory Instrument Management Systems.

The PC based application is developed on .NET platform. EVC v3.0 is used for Windows CE application on ARM platform. The local data storage on the device is performed via serialized flat files. Storage on PC, and data maneuvering and offline report generation are performed via MS Access. Crystal Reports is used for displaying and printing reports.

Our customer is a manufacturer of water and waste water monitoring products, and chromatography instruments. The customer looked to an embedded systems provider to outsource application development for chromatography instruments, and water and waste water monitoring products. The objective in partnering with an embedded systems provider is to lower development and maintenance costs for new and existing products, achieve quicker time-to-market, and drastically reduce TCO.

In a continuing partnership for over four years, Mindteck's dedicated development team has been involved in the development of liquid chromatography and flow measurement products. Mindteck offers multiple services to the customer at different levels of the product development lifecycle, including end-to-end product development, reengineering and sustenance engineering services.

A key engagement with this customer involves developing an advanced flow data management application. This application has plentiful features for analysis, editing and reporting of flow data. The application connects a host of water and wastewater monitoring instruments like flow loggers and flow meters, and provides easy to use instrument configuration options. Special features like configuration replication help in quick setup while replacing instruments at onsite locations. Data handling options are easy to perform in every case where data needs to be quickly downloaded onsite to a laptop.

Superior data presentation features facilitate presentation of data in graphs and tables. Easy drag and drop options, and graphs with up to four panes (with multiple data types in each pane), provide complete ease of use in data presentation to users. Advanced data analysis features allow users to conduct advanced and streamlined studies, and generate high-level reports. Some of the advanced data analysis features include

calculating average, minimum, maximum, and total accumulated values; comparing data from multiple sites using series formulas to determine the relation between sites or parameters; comparing flows using the continuity equation and Manning formula. High-level editing features allow easy editing, even where data quality can be adversely affected by external noise and other site conditions. Data can be edited with constant offset, fixed offset, proportional, time, or auto-correct functions. The reporting feature allows easy inclusion of graphs and tables in MS Word, Excel and PowerPoint. Data can be exported to CSV format for analysis in spreadsheet programs and graphs. Exporting tables into HTML or PDF formats is also possible. The application is built with a high-level licensing system, allowing system configuration based on the type of license purchased by the user. A time-bound access copy is available for users to evaluate the application before purchase. The application supports multiple databases including MS Access, MS SQL and Oracle. The application implements 'data push' technology where it accepts data packets pushed from multiple devices, translating into remarkable battery savings when compared to the earlier 'data pull' technology.

Another engagement for the same customer involves complete lifecycle management for liquid chromatography product lines. The chromatography product line includes instruments for purification of organic compounds in normal-phase and reversed phase separations, and bio-purification of proteins, peptides, and other biopolymers. We are offering product development, reengineering and sustenance engineering services designed to help this customer leverage contemporary hardware and software platforms with a view to feature-enrich and extend life spans of chromatography products.

Liquid chromatography products provide outstanding performance in organic purification with wide-ranging applications in drug discovery, and agro - and petro-chemistry. The control software developed by Mindteck is feature-rich, supporting higher throughputs, user-friendly accessibility, and flexibility of scale and separation methods. The system, powered by Intel's Celeron Processor running Linux, fully automates the liquid chromatography procedure.

Our avowed goal is to ensure high productivity with minimal user intervention and monitoring. The chromatography system can be controlled or monitored remotely through a web browser with an internet connection. The user receives an email alert when a separation process is complete. The LCD touch screen assists in controlling the system locally. Backed by a user-centric and aesthetic UI design, the system is highly intuitive. The instrument allows real-time method control. All method parameters can be altered during the run. By automatically detecting column sizes, the auto method configuration feature eliminates errors relating to column change. Conversions from normal to reversed phase can be completed quickly with minimal action. An optional feature that detects solvent volumes in each reservoir ensures that the system never runs out of solvents and facilitates rapid change of solvents. The UV wavelength is selectable from 200 to 360 nm. The reliable fraction collection system (using the customer's patented technology) can hold up to 288 tubes at a time, with an expanded capability feature allowing unlimited rack changes. Equipped with vapor and over-pressure sensors,

and a fully grounded solvent path, the instrument provides total safety.

As part of this engagement, Mindteck is involved in engineering applications for other products, which include the optional solvent management module and a high-capacity version of the organic purification system.

Our customer is a manufacturer of analytical and control instruments and software. The customer looked to partner with an embedded systems provider to reengineer products and chose Mindteck for this endeavor. The objective is to enhance different product lines, leveraging cutting edge technology. The engagement with Mindteck provides the customer greater flexibility to respond swiftly to technology and market changes with scalable products, reducing engineering spend and TCO.

Mindteck is involved in reengineering multiple products lines for this customer. One such engagement involves reengineering a series of PCBs for mass spectrometers and creating drop-in replacement for existing boards by incorporating contemporary technology. The reengineered boards have a lifespan of 5 to 7 years, are protected from component-obsolescence, converted to SMT technology and are totally RoHS compliant.

Other engagements involve providing electronics design services including extracting hardware specifications from product requirements, circuit design, PCB design, prototype assembly, board bring up, firmware development and integration. We offer sustenance engineering services that provide board reengineering required for implementing design enhancements, defect identification and fixing, replacing legacy components and redesigning for RoHS compliance.

Value proposition

Over the years, we have supported our customers in decisively architecting business value in multiple ways:

- o **Sustained top line growth:** We engineer products quickly and cost-effectively.
- o **Improved cost competitiveness:** We reduce TCO, saving on both upfront and ongoing costs.
- o **Strong value-gains:** Customers benefit from our exceptional domain and technology expertise, and on-demand intellectual capital availability.
- o **Accelerated time-to-benefit:** We slash total time-to-development through global delivery wherein our offshore resources produce high-quality deliverables and onshore teams ensure conformance to customer needs.
- o **Enhanced business focus:** Customers benefit from optimized resource utilization, sharpening their focus on core competencies.
- o **Greater agility in critical processes:** Customers achieve headways in business-focus, receptiveness, flexibility and processes, resulting in overall efficiencies and better knowledge management. ■

OPEN MIND: SHANKAR VELAYUDHAN, GROUP CTO, MINDTECK



Embedded systems are ubiquitous and are felt in every aspect of today's life. Companies aspiring to be innovative and competitive are using embedded systems as tools to realize their objectives. Embedded systems need expertise and domain knowledge to achieve desired results. Globally the trend

is towards outsourcing embedded systems development to trusted partners.

Mindteck, a leading embedded systems provider, has partnered with several leading product companies and helped them realize the true potential of embedded systems. **Mr. Shankar Velayudhan, Group CTO, Mindteck** in conversation with **Frost & Sullivan** briefs about Mindteck and the range of services offered to its customers.

Frost & Sullivan: What is the range of services offered by Mindteck in embedded systems? What would be Mindteck's focus in future both in terms of markets and technology?

Shankar Velayudhan: Mindteck specializes in the design and development of embedded systems. Our portfolio comprises of a complete range of solutions - product development, embedded software development, electronics design, verification and validation services. We specialize in Test & Measurement, Semiconductor Manufacturing, Wireless and Medical Devices market segments. We have strong competency in these areas and we are building on these competencies. To improve customers' overall business rewards from outsourcing our strategy meshes belief-sets such as customer value creation and enhancement and this manifests in our end-to-end solutions for the above-mentioned market segments.

Frost & Sullivan: What would you like the analytical instruments industry participants to know about Mindteck?

Shankar Velayudhan: In effect, Mindteck functions as the extended engineering arm of the analytical instruments manufacturer. Outsourcing is a critical business strategy for every forward-thinking enterprise. Mindteck helps analytical instrument manufacturers reap full business rewards from outsourcing. The need and rationale underlying outsourcing vary with enterprise: propel growth through product and value differentiation, build agile organizations for real-time responsiveness to competition and manage inadequacies in organizational skills or just all of them. Mindteck's customer value creation and enhancement strategy, being the focal point, guarantees success in every case.

Apart from addressing industry-wide challenges, we have helped analytical instrument manufacturers drastically reduce overall engineering costs and successfully manage risks. We have authored a string of

success stories in outsourced embedded systems development even as instrument manufacturers have saved more than 55% of their project execution costs by moving development efforts to us. Beyond cost competitiveness, we offer value-gains through deep domain and technology expertise, managed delivery and operations, accelerated time-to-benefit, greater agility in key processes, and enhanced transparency. Today Mindteck is increasingly perceived as an extended engineering arm of analytical instrument manufacturing companies.

Frost & Sullivan: Global product companies have started realizing the potential for deriving the high end value added activity in embedded system design and software development from Indian companies. How is Mindteck poised to take vantage of the opportunity for future growth?

Shankar Velayudhan: While outsourced product development to Indian companies is certainly on the upswing, we also see an incredible opportunity in outsourced innovation. With a view to accelerate time-to-market, infuse greater agility into key processes, and slash costs most companies in the markets we operate are looking to farm out R&D alongside product development.

Today we work for several global product companies providing core embedded systems development services. We currently work on engagements where the highest level of product creation is done by our customers and the job of turning the concept into actual product is done by us. Working on such engagements is rife with challenges. Conflict of interest and intellectual property protection are critical issues requiring elaborate planning. Both sides need to work closely from Day 1 getting relationships right. Being a pure services player, we do not compete with product companies. Instead, our work-for-hire model unequivocally recognizes our customers as owners of the products we develop for them.

Mindteck's global development centers are well equipped with latest technologies for enterprise-wide communication and networking, productivity, collaborative software engineering, and distributed project management. All development facilities are governed by centrally administered policies. These policies are benchmarked globally for physical and network security, data and project segregation and protection, and business continuity planning. We are hence well-placed to tap into the outsourced product development and outsourced innovation opportunities.

Frost & Sullivan: Quality has become a default deliverable in today's business. What are the initiatives that Mindteck has undertaken to impart quality into its business process and deliverables?

Shankar Velayudhan: Embedded systems have become ubiquitous: they can be found in a vast variety of products around us. And consequently, defect-management has given way to defect-prediction and timely resolution.

At Mindteck, quality is a way of life touching every process, interaction and deliverable. It goes beyond simply delivering error-free solutions. We view our processes and methodologies as inherent features enabling us to exceed customer expectations. Processes at Mindteck are benchmarked against international standards like ISO 9001 and CMM. Mindteck is an ISO 9001:2000 and BS7799 certified, SEI CMM level 4 assessed company. Our project management processes are supported by practices in line with the CMM guidelines. Our iterative development approach and incremental release strategy ensures end products' compliance with customer-specifications and on-time deliveries with no unpleasant surprises whatsoever. We understand that working with external development partners can be challenging for customers. At Mindteck, we have invested in processes, tools and methodologies to guarantee efficient customer relationship management. Our web-based tools with customer portals and information dashboards provide real-time project status.

Frost & Sullivan: In the highly competitive analytical instruments market, product innovation and cheaper, accurate products have become critical success factors for the manufacturers. How does the embedded system help the manufacturer in this market scenario?

Shankar Velayudhan: In a market space besieged by ever-increasing competition, shrinking product lifecycles and narrowing differentiations, embedded systems play a crucial role in the success of an analytical instruments company. While instruments are the major sources of accurate, reliable and real time information, embedded systems are the critical constituents powering analytical instruments. Embedded systems design by virtue of its modularity, usage of standard operating systems (WinCe, Linux), GUI and communication protocols (USB, Wi-Fi and ZigBee) facilitates distribution of design costs across multiple instruments, and provides time-to-market advantages.

Now that processing speeds and communication technologies have scaled up significantly in quick time, instrument manufacturers are under severe pressure to constantly upgrade products, crunching development lifecycles. Embedded systems provide instrument manufacturers the edge to be innovative, address market requirements and still remain competitive. Instrument manufacturers should decide on swifter rollouts of product variants and at the same time provide excellent customer support, while containing costs. In such a scenario, it takes a global embedded systems partner to deliver these benefits of innovation in embedded systems, accelerated time-to-market and cost advantages.

Mindteck Insight is your platform, whatever be your shaping role in industry: CXO, Analyst, or Industry Researcher. Together let's keep the dialogue going and growing. Write to us at embedded@mindteck.com.

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Frost & Sullivan: What are the key aspects that an analytical instruments manufacturer should look for in an embedded systems solution provider while partnering with them?

Shankar Velayudhan: To begin with, manufacturers should look only for a true partnership and not a plain customer-vendor relationship. The partner must acknowledge that it's a relationship, not just a project. Cultural compatibility is a prerequisite. The partner's experience in both domain and core technologies is critical to success. Track record should be considered to benefit from the partner's capability in project execution. Delivering consistently from remote low cost locations has never been easy. Hence, a detailed walkthrough of the delivery models is imperative. Quality certifications by themselves do nothing to foster and further working relationships. It is important, therefore, to look for matured program governance and comprehensive engagement models alongside certifications and assessments. A quality metrics program is important and needs to be assessed. Visiting the delivery centers and interacting with technical staff is essential for a firsthand assessment of facilities, people, security measures and business continuity preparedness.

In short, the partner's value proposition must evidently seek to enhance value creation apart from reducing cost.

Read the complete Movers & Shakers interview with Mr. Shankar Velayudhan on the Test & Measurement portal on www.frost.com. Frost & Sullivan's Movers & Shakers column highlights the most dynamic companies and leaders within the Test & Measurement Industry. Movers & Shakers focuses on dynamic companies and leaders for their outstanding achievements and events such as the launch of a breakthrough technology, a strategic acquisition or a revolutionary vision for the future of the Test & Measurement industry. ■