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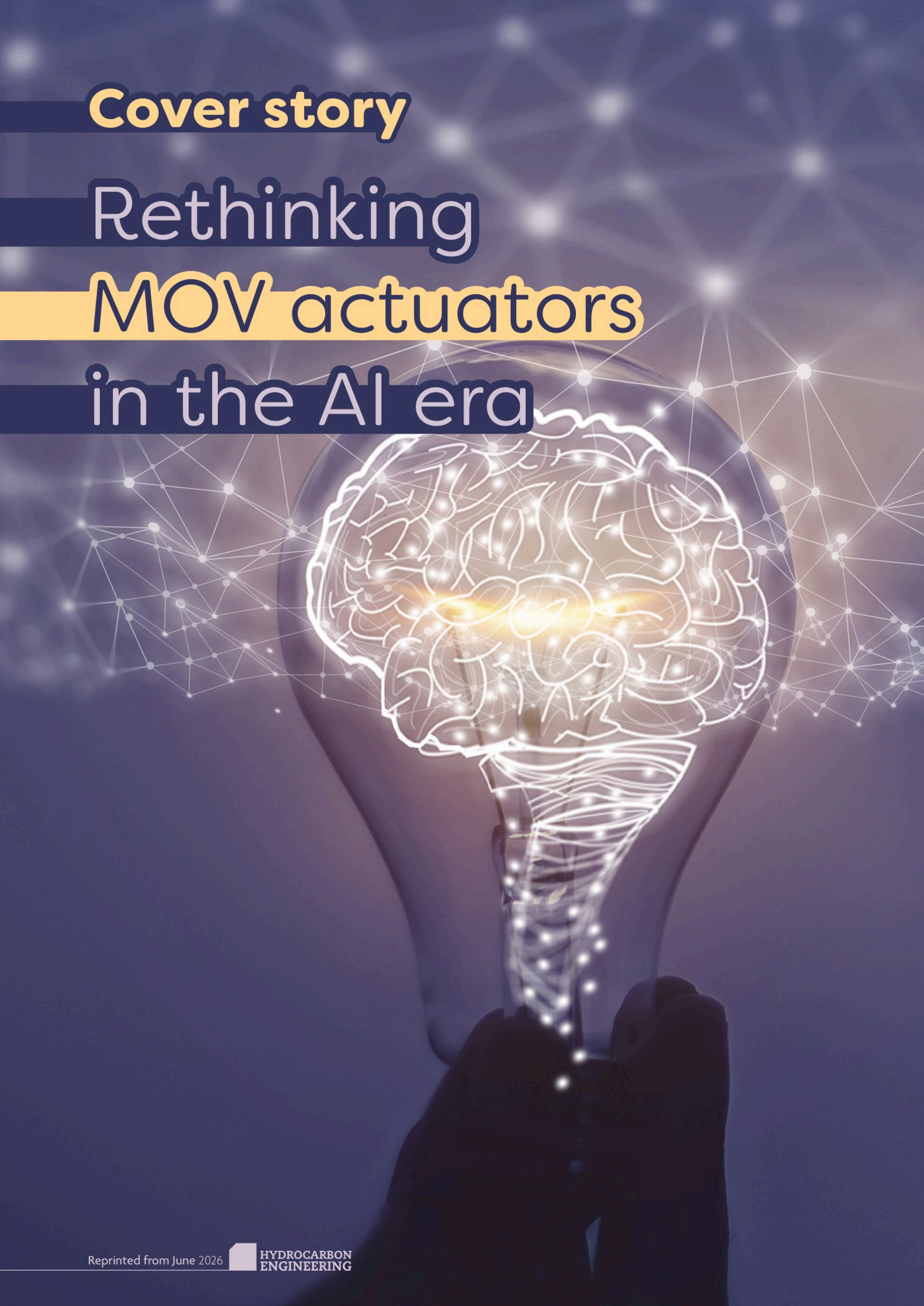
THIS MONTH'S FRONT COVER

Wonder®'s vision is to become a leading instrumentation brand in the oil and gas and energy industries, originating from Singapore. By embracing cutting-edge technologies in process applications, Wonder aims to deliver flexible and efficient solutions while continuously creating value by bridging the gaps between market expectations and user needs, as well as between technological advancements and industrial practices.

Cover story

Rethinking MOV actuators in the AI era



Michael Li Panfeng, Wonder Engineering Technologies Pte Ltd, Singapore, examines the transition of motor-operated valve (MOV) actuator development from hardware-centric design to application intelligence, digital integration, and service-oriented engineering.

Motor-operated valve (MOV) actuators have long been a core component of industrial automation, particularly in the oil and gas and energy sectors, where their performance directly affects operational reliability.

Historically, differentiation was based on mechanical robustness and electrical reliability. However, as actuator hardware has matured and become standardised, these factors no longer provide meaningful differentiation. Positioning 'full in-house manufacturing' as a core capability may no longer indicate superior engineering, but rather potential inefficiencies in resource allocation.

Today, MOV actuator value is increasingly defined by data accessibility and system-level intelligence rather than hardware capability. Engineering value is shifting from components to integrated systems and data-driven optimisation.

Concurrently, advances in artificial intelligence (AI) and consumer technologies are accelerating the integration of digital tools into industrial environments. These developments are redefining how actuators are operated, monitored, and maintained.

Augmented reality (AR) enhances field maintenance and site survey efficiency, while virtual reality (VR) enables scalable training and knowledge retention. Together, these technologies support the transition toward data-driven and digitally integrated plant operations. To illustrate this transition from concept to practical implementation, this article will explore a field case study of this development in Singapore.

Application development example: AR glasses for MOV field survey/maintenance

The development of AR glasses originated from an MOV replacement project carried out at an ageing refinery in Singapore in 2021. During the site survey phase, significant inefficiencies in traditional field practices for assessing existing MOV installations were identified.

Field data collection relied primarily on manual recording of tag numbers and photographing nameplates based on visible site information. However, more than 60% of the 37 installed MOV units had no corresponding datasheets or records in the end user's database, resulting in a lack of reliable reference data.

In principle, nameplate information could be used to trace basic actuator specifications. In practice, this approach was severely constrained. Many units were fitted with degraded fireproof enclosures, which limited or prevented access to nameplates and internal actuator information. Even when accessible, critical data – such as actuator configuration and valve stem thread specifications – remained unavailable.

As a result, on-site measurements were required, but site conditions often prevented the precision needed for machining. Consequently, only basic parameters such as flange size and valve stem diameter could be confirmed, and coupling adaptors were supplied as blind components. Final machining had to be completed on site after actuator removal, followed by re-measurement and overnight machining.

Figure 1. Wonder AR: on-site MOV data access interface.

Figure 2. Conventional MOV replacement site survey.

This introduced additional cost, schedule constraints, and operational limitations due to restricted valve bypass durations.

For this project, the site survey involved three vendor engineers and two end user engineers over six days, plus one additional day for data retrieval, totalling approximately 32 man-days.

During installation, the use of blind coupling adaptors prevented batch execution. Each valve required removal of the fireproof enclosure, on-site measurement, and overnight machining, limiting installation progress to a maximum of two valves per day. This resulted in 18 overnight machining shifts, involving additional labour and expedited costs.

Based on an average labour cost of US$600 per man-day and US$1200 per night shift, the direct additional cost was US$40 800 (based on 32 man-days and 18 night shifts).

For 37 MOV units, this corresponds to approximately US$1100 per unit, excluding indirect costs such as scaffolding, work permits, and standby requirements.

To address this gap, AR glasses were developed as industrial field terminals with application layers tailored for MOV actuators.

In this approach, by scanning a barcode or QR code attached to the actuator, engineers can immediately access key specifications, configuration data, and real-time operating parameters, which are centrally managed in a digital database and linked to the physical asset. This eliminates the need for manual data retrieval via laptops or reliance on control room communication.

Field engineers are only required to perform limited measurements for cross-verification. For units fitted with fireproof enclosures, removal is no longer required, reducing both risk and effort.

As a result, the site survey process is significantly improved. A typical survey can be completed by two engineers – one from the end user and one from the vendor – within two working days, equivalent to four man-days.

The total survey cost is reduced to US$2400, at the same average labour cost of US$600 per man-day. For 37 MOV units, this corresponds to approximately US$65 per unit, compared to approximately US$1100 per unit using conventional methods.

Application development example: VR glasses for MOV training and knowledge retention

During field installation for the same project, the end user requested training support, deploying two batches of field technicians (six personnel per batch) over two days. Wonder Engineering provided three engineers to conduct the training within the same period. A similar approach was applied at other sites in Singapore, even for installations involving only a small number of MOV units, resulting in repeated mobilisation of personnel for short-duration training sessions.

While the training was successfully delivered, this approach highlights two fundamental limitations: the reliance on individual trainers' experience and delivery quality, and the difficulty in ensuring long-term knowledge retention and effective application in actual operations.

Traditional training methods are resource-intensive, difficult to scale, and often inconsistent. VR addresses these limitations by enabling repeatable, standardised, and risk-free training in a controlled environment.

The adoption of VR significantly reduces reliance on conventional training approaches by minimising repetitive classroom sessions, refresher training, and vendor-led instruction. This enables a substantial reduction in mobilisation, manpower, and training costs, equivalent to an estimated saving of approximately 24 man-days for two batches of 12 electrical and instrumentation (E&I) field technicians over a two-day period, in addition to lower training effort and associated costs.

More importantly, VR enables the consolidation of MOV-related knowledge into a structured and reusable digital system, allowing engineers to access and apply it on demand.

This reflects a transition from event-based training to continuous, data-driven, and AI-assisted capability development. More fundamentally, it demonstrates that the primary limitation of conventional MOV training lies not in content delivery, but in knowledge retention and accessibility.

From a system architecture perspective, both AR and VR applications share a similar design principle. They function not as a control layer, but as an edge-level visualisation and decision-support interface. The system operates in read-only mode, with no write-back capability, and remains fully isolated from plant control systems. It uses short-range communication (e.g., Bluetooth), avoiding reliance on plant network infrastructure, which is often restricted or unreliable in hazardous environments.

This layered architecture separates data acquisition, communication, and visualisation, ensuring scalability, security, and ease of deployment. Rather than transmitting large volumes of data, the system prioritises contextual delivery of relevant information at the point of use.

Table 1. Conventional vs AR-enabled field survey

Aspect	Conventional approach	AR-enabled approach
Data access	Manual recording + photos	Instant via barcode/QR scan
Data availability	>60% missing	Centrally managed, complete
Fireproof enclosure	Must open (risk of damage)	No need to open
Measurement	Primary data collection	Cross-verification only
Survey team	5 engineers	2 engineers
Duration	6 days	2 days
Total man-days	Approximately 32	4
Coupling machining	On-site, overnight	Factory pre-fabrication
Installation efficiency	Maximum of 2 valves/day	Batch installation possible
Survey cost per unit	Approximately US$1100	Approximately US$65
Risk level	High (assumptions required)	Low (data-driven)

Figure 3. Wonder VR: MOV plant database and virtual hands-on training

Table 2. Conventional vs VR-based training

Aspect	Conventional training	VR training
Trainer dependency	High	Low
Repeatability	Limited	Unlimited
Knowledge retention	Low	High
Cost	High	Reduced

Where engineering value is created in the AI era

Practical implementation shows that inefficiencies in MOV field work are primarily driven by limited data accessibility rather than execution capability. By enabling real-time, contextual access to asset information, AR transforms field activities from manual data collection into data-driven verification processes, significantly reducing engineering effort, cost, and operational risks.

Similarly, the VR-based approach highlights that the key limitation of traditional training is not the absence of content, but the lack of persistent, accessible, and reusable knowledge systems.

By enabling simulation-based interaction and

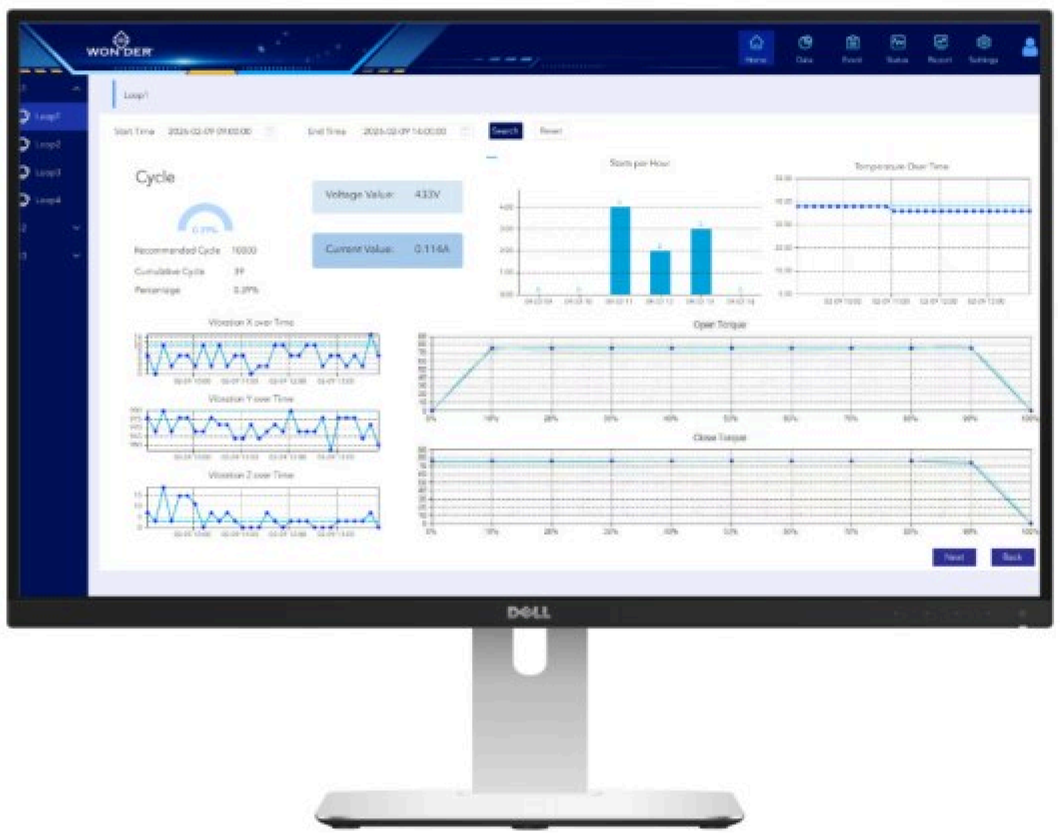


Figure 4. Wonder MMS: MOV monitoring system.

Figure 5. Wonder AR: real-time on-site data interface.

on-demand learning, VR supports a transition from event-based training to continuous capability development, improving both knowledge retention and operational consistency.

These findings indicate that AR and VR are not standalone technologies, but enabling interfaces that integrate data, diagnostics, and engineering knowledge into daily operations.

This shift suggests that future industrial competitiveness will not be determined by hardware capability alone, but by the ability to structure, manage, and deploy engineering knowledge effectively. The real engineering value is therefore created at the system level through the effective integration of hardware, software, data, and human expertise.

This reflects a broader transition in industrial automation, particularly in MOV actuator applications – from device-centric engineering to system-level performance driven by data integration and knowledge management.

Acknowledgements

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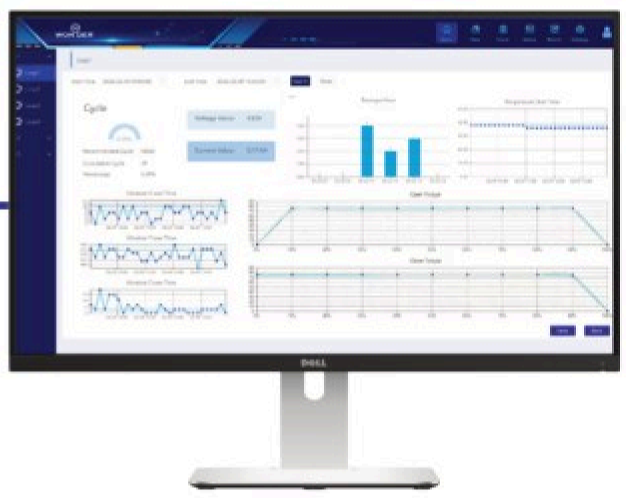

MMS
(MOV Monitoring System)

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