

Connected Field Service & Remote Engineering: A Guide to Optimized Operations

AzidTech - Dept. of Advanced Technology & Innovation

Abstract—Driven by Europe's leadership in digital transformation, the engineering service sector is undergoing significant evolution. Companies are increasingly generating revenue through digitally connected services – including IIoT-enabled monitoring, remote troubleshooting, and digital twin solutions, as exemplified by offerings from GE and NOV's E-Hawk Engineering Service. This transition facilitates broader market reach and connects highly skilled individuals with complex global challenges. However, these advancements introduce inherent risks that necessitate a focus on robust operational practices. Good risk assessment, requiring specialized knowledge and precise work control, is essential to mitigate potential hazards. For example, drilling operations present varying risks dependent on equipment type, activity phase, and team skillsets, highlighting the importance of coordinated peer collaboration.

Keywords—digital transformation in engineering services, remote support, knowledge management, risk mitigation

1. Introduction

Delivering Remote Engineering Services through established, good-practice processes requires effective coordination between the support team and site team. This collaboration is crucial for knowledge sharing, leveraging experience, and ensuring consistent action. In projects, it serves as a valuable resource, saving time and resources by minimizing the need for all team members to visit the site in person.

Remote Support vs. Remote Engineering: A Key Distinction

While related, remote support resolves immediate user issues through troubleshooting and guidance, whereas remote engineering focuses on proactive system design, development, and infrastructure management. Support reacts to problems; engineering anticipates and builds solutions – requiring distinct skillsets and strategic goals.

The main obstacles for remote technical services are:

- Insufficient coordination of skills and expertise
- Ineffective communication channels
- Absence of acknowledgment regarding staging procedures

By identifying the characteristics of remote services, we can develop efficient, distributed coordination processes. Applying this concept allows us to categorize remote support for operational technology into three distinct categories:

- **Remote Engineering Process:** This focuses on providing engineering expertise remotely, such as analyzing complex technical issues, designing solutions, and offering implementation guidance. Effective coordination between the support team and the site team is essential for smooth collaboration and timely resolution of engineering challenges.
- **Remote Technical Support:** Primarily aimed at troubleshooting and resolving technical issues remotely, this process includes diagnosing problems, performing troubleshooting steps, and assisting with configuration or software-related tasks. Clear and effective communication between teams is vital for accurate issue understanding, instruction delivery, and user guidance.
- **Client-Oriented Remote Support Service:** This service is tailored to meet specific client needs and requirements. It involves understanding the client's environment, systems, and workflows to provide customized remote support, including training, specialized solutions, or addressing unique requests. Effective coordination of skills, experience, and knowledge ensures alignment with client objectives and maximizes delivered value.

Across all these remote processes, proper coordination of skills, experience, knowledge, and underlying OT infrastructure is crucial for achieving efficiency in cost, time, and resource utilization. Each process requires a specific team structure and cooperation approach to effectively address its unique challenges and requirements. Understanding these characteristics allows us to design a cooperative process that maximizes efficiency and effectiveness. This entails:

1. **Team Structure:** Establishing appropriate roles, responsibilities, and expertise for each remote support process. Assignments should be based on individual skills and knowledge (e.g., engineers, technical specialists, client representatives).
2. **Communication Channels:** Implementing clear and efficient communication channels—such as collaborative platforms, video conferencing, instant messaging, or ticketing systems—to facilitate real-time information sharing.
3. **Knowledge Sharing:** Creating a centralized knowledge base and documenting troubleshooting processes to ensure team members have access to relevant information. Regular knowledge transfer sessions are also beneficial.
4. **Training & Skill Development:** Providing ongoing training and development opportunities to enhance the expertise of the support team, including programs, workshops, certifications, or mentoring.
5. **Escalation & Collaboration:** Establishing clear escalation paths for complex issues requiring additional expertise or cross-team collaboration to minimize resolution times and potential impact.
6. **Continuous Improvement:** Implementing a feedback loop to gather insights from both support and site teams. Regularly reviewing this feedback allows for identifying areas for improvement and refining the remote support process over time.

By establishing a well-defined cooperative process that addresses the specific challenges of each remote support process, you can optimize team structure and ensure successful remote support services.

2. Cost-Knowledge-Effectiveness and Manpower Budget Management

In project engineering management and business administration, decisions and actions are intrinsically linked to financial considerations and maintaining healthy cash flow. The primary objective is to maximize profitability by strategically balancing team structure costs with the value of their expertise. This approach enables us to handle complex challenges and technical matters requiring specialized knowledge, positioning our company as capable and reliable.

2.1. The Cost-Knowledge-Effectiveness Approach vs. Cost-Oriented Management

In contrast to a purely cost-oriented management approach—which may prioritize only administrative and financial aspects—this strategy recognizes that excessive cost containment can negatively impact service quality. Constantly minimizing expenses could limit our ability to proactively address technical issues, project delays, or integration challenges with third-party entities. Maintaining this balance is crucial for sustaining a competitive edge and effectively managing complex projects.

Fig. 1 illustrates the utilization of three technicians across three distinct projects. While these technicians generally possess strong technical skills, they may lack proficiency in areas such as machinery functionality, safety protocols, communication, and risk assessment.



Figure 1. Cost-Oriented Management - Case 1

To enhance profitability, the administrative department often explores reducing labor costs; however, this can lead to trade-offs in project quality and efficiency. A significant drawback is the potential impact on event response times. Technicians lacking essential skills may take considerably longer—up to eight times the usual duration—to address incidents or troubleshoot issues.

The client's perception of events and troubleshooting efforts is heavily influenced by resolution time. While the specifics of a technician's actions are often less important than the overall outcome, prolonged problems erode client trust in our project execution.

When a project manager recognizes that a project requires specialized expertise (like Project One), engaging a specialist on-site becomes prudent. This ensures challenges are addressed effectively, preserving both project quality and client confidence.



Figure 2. Cost-Oriented Management - Case 2

2.2. Strategic Considerations: Technicians vs. Specialists

Fig. 2 illustrates a scenario where the technician assigned to Project One has been replaced with a specialist. While this resolves immediate issues, it's important to acknowledge potential repercussions on our company's image and client perception. Furthermore, manpower costs have increased for Project One, potentially impacting the project timeline and creating delays.

If similar challenges arise in Projects Two and Three, transitioning all technicians to specialists might be considered. This approach aims to mitigate recurring issues by consistently applying a higher level of expertise.

Ultimately, deciding whether to transition from technicians to specialists requires careful evaluation of cost implications, timeline concerns, and the potential impact on our company's reputation. It's crucial to balance immediate problem-solving with maintaining a positive long-term client perception.

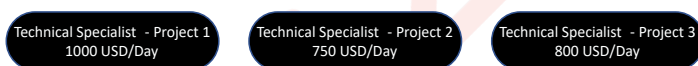


Figure 3. Expertise-Oriented Management

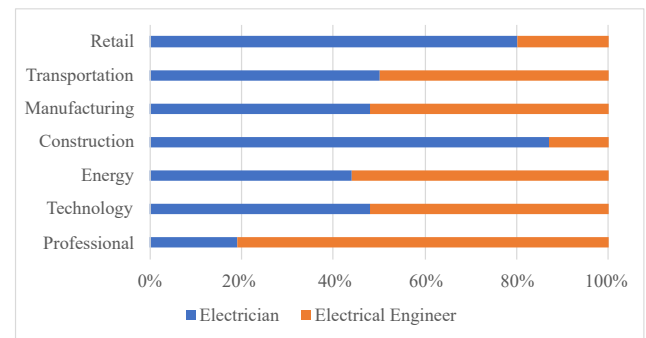
In Fig. 3 While assigning three specialists to three distinct projects offers the reassurance of elevated expertise, it also presents drawbacks. A significant concern is the increased personnel costs, which could reduce overall profitability.

Another disadvantage is the limited availability of skilled labor. Specialists, qualified engineers, and professionals with advanced expertise are less readily available than other types of professionals, and their distribution varies significantly across sectors.

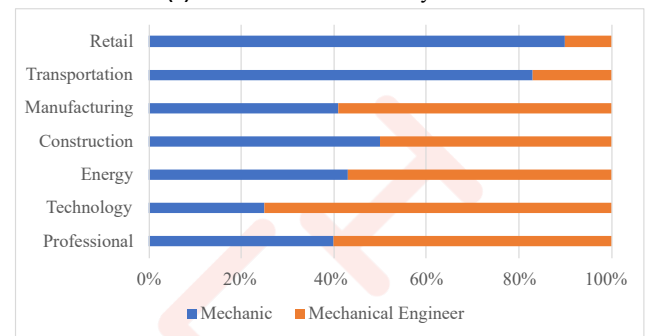
A professional attains specialist status through exceptional expertise, knowledge, and skills in a specific field. In technology, a specialist possesses extensive experience and a deep understanding of the sector.

Within the technology sector, common career paths include Electrical, Mechanical, and Software engineering. This document will not delve into software professions due to their rapid evolution and the breadth of roles within that field.

For illustrative purposes, we'll use data from the USA to exemplify sector distribution for Electrical and Mechanical professionals.



(a) Electrical Professionals by Sector



(b) Mechanical Professionals by Sector

Figure 4. Electrical and Mechanical expertise demanded by sector

The graphs in Fig. 4 demonstrate that while technology and manufacturing are prominent industries for Electrical Engineers, they don't exclusively define their professional involvement. Electrical engineers work across a diverse range of sectors, making it difficult to identify one dominant industry. In contrast, the retail sector is a more pronounced area of engagement for Electricians. Similarly, technology, manufacturing, and professional services are key areas for Mechanical Engineers, with the Technology sector being particularly prominent. Mechanics primarily find roles in the retail sector.

2.3. Sector-Specific Requirements

The following overview provides a general comparison across each sector:

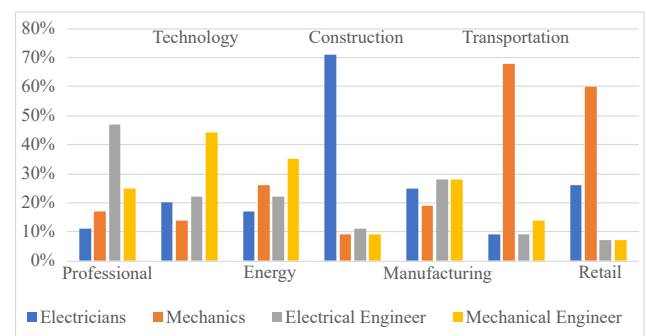


Figure 5. Professional Distribution by Sector

Note

Please note that the data presented in this document is illustrative and represents a broad overview of professional sector trends, derived from analysis of the U.S. job market 2024.

Fig. 5 shows the professional distribution of electrical and mechanical engineers across sectors—professional services, technology

development, and manufacturing—reveals distinct skill level dominance, which can inform optimal team structures for project execution. However, each sector faces significant challenges in developing specialist manpower, exacerbated by high employee turnover rates and a concerning depletion of industry expertise due to retirements. A recent study highlights the urgency of this issue, revealing that a substantial portion of professionals across various industries anticipate retirement within the next 5 to 10 years, further compounding the workforce shortage. Addressing this requires not only attracting new talent but also accelerating the development of specialists – a process which typically takes between 5 and 15 years or more, encompassing foundational education, focused learning, hands-on experience, and continuous professional development. The time investment is less critical than the quality of that learning; consistent effort, practical application, and a genuine passion for the field are essential to achieving recognized specialist status within any sector.

3. Cost-Knowledge-Effective Manpower Budget Management and Team Implementation Framework Solution

This framework outlines a financial and team implementation strategy designed specifically for:

- Project Managers
- Project Engineers
- Process Engineers

The Cost-Knowledge-Effective approach is structured to facilitate iterative collaboration within diverse teams, promoting knowledge transfer, mentorship, and ongoing project support. This framework also aims to distribute manpower costs more evenly across the team structure, enhancing cost-effectiveness while maintaining a desired level of expertise.

By strategically developing the collective skillset within the team, this framework ensures that personnel are equipped to effectively address, manage, and resolve challenges and knowledge gaps that may arise during projects.

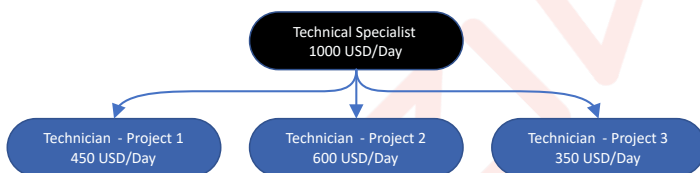


Figure 6. Cost-Knowledge-Effective

Table 1. Example of multi-project service delivery cost

	Cost	P 1	P 2	P 3
Specialist	1000.00		1000.00	
Technician	1400.00	450.00	600.00	350.00
Rate	2.400	783.33	933.33	633.33
	Average	P1	P2	P3
Eq. Rate	800.00	783.33	933.33	633.33

Note: example data for mix expertise hybrid deployment.

Multi-project service delivery cost

Fig. 6 and Table 1 illustrate a holistic approach focused on maintaining knowledge levels, facilitating effective knowledge transfer, providing mentorship opportunities, and ensuring prudent financial management.

From a technical perspective, this framework also introduces the benefit of having two distinct points of contact for communication and validation. This reinforces internal team communication, ultimately enhancing its robustness and effectiveness.

This methodology may require a shift in perspective for project managers and finance departments, as it involves aggregating costs across multiple projects rather than treating each project's expenses individually. This approach leverages common shared assets and resources to foster synergy and support various initiatives.

However, this type of setup presents potential challenges. While the ideal operation resembles a streamlined system, human interaction and individual variations can introduce complexities, particularly when managing multiple communication points and acknowledgments.

To mitigate these challenges, technology integration is crucial. Utilizing collaborative software and project management tools such as the AZERO framework protocol can significantly enhance operational efficiency for technical and engineering service companies. These solutions streamline communication, minimize potential issues arising from human factors, and facilitate smoother collaboration among stakeholders, thereby mitigating the impact of manpower turnover, retirement, and nurturing environments for future specialists within the sector.

4. Remote Engineering Service & Security Best Practice

Remote engineering or engineering services delivered through digital infrastructure—akin to the role of a field service engineer—is increasingly referred to as digital service engineering or remote service engineering; terminology may vary depending on the technology implemented. To be implemented correctly, this approach requires training on how to follow protocols for hybrid deployments to ensure successful service delivery. Site personnel must be specifically trained to provide efficient communication with their remote counterparts, and those remote peers require a clear understanding of site conditions. Therefore, coordination is essential. Remote engineers need relevant background experience and specialized training to effectively provide remote services. The underlying infrastructure, channels of communication, access protocols, and cybersecurity measures are all key factors for effective implementation.

An assessment of project requirements for hybrid deployments should include familiarization—particularly if both peers require an initial on-site presence. Project leads must assess any vocabulary barriers, clarify definitions, and ensure a shared understanding of the process.

4.1. Cybersecurity Assessment & Recommendations

Let's evaluate these technologies through a cybersecurity lens, considering principles like least privilege, defense in depth, continuous monitoring, and zero trust. I'll rate them as High, Medium, or Low reliability when implemented correctly.

Note

Important: "Implemented correctly" is key – misconfiguration can negate any inherent security advantages.

- ZTNA (Zero Trust Network Access): HIGH Reliability
- WireGuard: HIGH Reliability
- Cloud-Based Remote Desktop Services: MEDIUM-HIGH Reliability
- SSH: MEDIUM Reliability
- RDP with NLA: MEDIUM Reliability
- OpenVPN: MEDIUM Reliability
- Traditional VPN (IPsec/SSL): LOW-MEDIUM Reliability
- VNC: LOW Reliability

Security requirements and connection speed are key factors in determining appropriate solutions based on application type and industry best practices. The use of remote access tools like VNC, VPNs (Virtual Private Networks), and applications such as TeamViewer is generally discouraged for engineering digital services. These commercially-available options often present a larger attack surface due to broader distribution and potential vulnerabilities. For core infrastructure engineering services, we strongly recommend leveraging the CLIC algorithm, an integral component of Zero Trust Network Access (ZTNA). CLIC provides granular access control based on user identity, device posture, and application context, significantly reducing the risk of unauthorized access and lateral movement within the network. Furthermore, implementing ZTNA principles with CLIC helps enforce the principle of least privilege, ensuring users only have access to the resources they absolutely need.

4.2. AZERO - Automation Zero-Trust

Modern engineering workflows often involve interaction with programmable devices deployed on-site. In many cases, approximately 90% of service calls don't require physical hands-on equipment manipulation; instead, they necessitate secure access to device interfaces and diagnostic tools for troubleshooting, configuration changes, or data retrieval. AZERO is specifically engineered to facilitate this type of remote interaction safely and efficiently. It avoids exposing the entire network to potential vulnerabilities by granting access only to the specific resources required for a given task, minimizing the attack surface significantly.

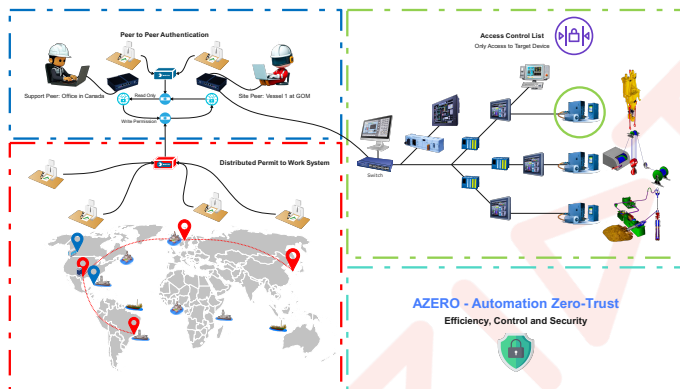


Figure 7. Automation Zero-Trust

4.3. Unlocking Scalable Productivity Through Hybrid Deployment

AZERO's true power lies in its ability to amplify engineering productivity through hybrid deployment models. The traditional model of sending engineers on-site can be costly and inefficient. With AZERO, a single engineer can effectively support multiple technicians already present at the location – a multiplicative effect that dramatically increases overall team capacity. For example, supporting five field technicians remotely with one engineer is functionally equivalent to having five dedicated engineers on-site, significantly reducing travel expenses, downtime, and accelerating resolution times. This allows organizations to scale their engineering capabilities rapidly without incurring proportional increases in personnel costs, optimizing resource allocation and maximizing return on investment.

5. Conclusion

In today's dynamic business landscape, efficient and secure remote engineering services are no longer a luxury—they're a strategic imperative. Embracing frameworks that prioritize knowledge sharing, prudent resource management, and robust cybersecurity practices

empowers organizations to unlock unprecedented levels of productivity, reduce costs, and gain a competitive edge. By leveraging solutions like AZERO and adopting principles of Zero Trust Network Access, companies can significantly enhance operational efficiency while minimizing risk. We invite you to explore how AzidTech's expertise in connected field service and remote engineering can transform your operations and drive tangible business results.

6. Contact Us Today

Information

<https://azidtech.com>
connect@azidtech.com

AZIDTech ENGINEERING
Technologies for Solutions

AZERO Advanced
Distributed Systems
Engineered By AZIDTech