

Quality inspection personnel training and team construction research of power plant installation and construction units

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Abstract: With the rapid development of the energy industry and the continuous improvement of technological levels, the quality control requirements for power plant installation and construction are increasingly stringent, raising higher demands on the professional abilities and team development of quality inspection personnel. This study focuses on the training and team building of quality inspection personnel in power plant installation and construction units, aiming to explore effective methods to enhance the professional skills of quality inspectors and the overall efficacy of the team. Through an analysis of the current training systems and team building status of quality inspection personnel, this research proposes a series of innovative training models and team building strategies, including simulated training, on-the-job training, the establishment of competency assessment and certification mechanisms, as well as organizational structure optimization, career path design, and the development of a quality culture. The study demonstrates that by implementing these strategies, the professional skills of quality inspectors can be effectively enhanced, team cohesion and quality awareness can be strengthened, thereby improving the overall quality and efficiency of power plant installation and construction projects.

1. Introduction

In the current context of rapid development in the energy sector, the quality of power plant installation and construction projects is directly linked to the stable operation of the power system and the security of energy supply, making the assurance of construction quality a critical focus of industry development. As key players in ensuring construction quality, enhancing the professional capabilities and team efficacy of quality inspectors is especially important. However, facing complex construction environments and increasingly stringent quality standards, traditional training and team building models for quality inspectors are no longer adequate. This study is based on this context, through an in-depth analysis of the training needs and current team building status of quality inspection personnel in power plant installation units, proposing a series of innovative training models and team building strategies. The aim is to provide theoretical guidance and practical references for

the training and team development of quality inspection personnel in power plant installation units.

2. Training Program Design for Quality Inspection Personnel in Power Plant Installation and Construction Units

In power plant installation and construction projects, quality control is a key factor in ensuring the successful delivery of the project. In this process, the role of quality inspection personnel is particularly important as they need to possess extensive professional knowledge and the ability to accurately perform quality testing and control tasks, ensuring that construction quality meets national and industry standards. Therefore, systematic training of quality inspection personnel is of great significance for enhancing their professional capabilities, operational skills, and ability to handle emergencies[1].

2.1. Training Needs Analysis

In the quality control process of power plant installation and construction, quality inspection personnel play a crucial role. Systematic training is essential to ensure that these professionals can effectively fulfill their duties. Training needs analysis forms the basis for identifying key areas and content for training quality inspection personnel, aimed at identifying current and anticipated skill gaps and developing specific training plans to meet these needs. The following is a training needs analysis based on the actual requirements of power plant installation and construction:

2.1.1. Mastery of Technology and Standards

Industry norms and standards: Quality inspection personnel must be familiar with relevant national and industry quality standards and construction safety standards, including but not limited to GB 50222-1995 "Quality Acceptance Norms for Power Facility Installation Engineering" and ISO 9001 quality management system requirements.

Professional technical knowledge: In-depth study of the performance, usage conditions, and maintenance of power plant equipment and materials, understanding the potential issues during the installation process and their solutions.

2.1.2. Operational Skill Training

Practical skills: Through simulated practical training, enhance proficiency in operating various types of equipment during the power plant installation process, especially in critical phases such as installation, commissioning, and trial operation.

Quality testing skills: Improve skills in using various testing tools and equipment for quality testing, including non-destructive testing (NDT) and precision measurement.

2.1.3. Safety Awareness and Emergency Handling

Safety procedure training: Strengthen safety awareness during power plant installation and construction to ensure that quality inspection personnel are proficient in safety operating procedures, including the use of personal protective equipment and site safety management.

Emergency response capabilities: Develop the ability of quality inspection personnel to quickly respond to various emergencies that may occur during the construction process, such as equipment failure or safety incidents.

2.1.4. Soft Skills Enhancement

Communication and collaboration: As a member of the team, quality inspection personnel need to possess good communication and collaboration skills to effectively communicate with engineers, construction workers, and project management teams to ensure that quality control measures are correctly implemented.

Problem-solving skills: Enhance the problem analysis and solving abilities of quality inspection personnel so that they can propose timely and reasonable solutions when quality issues are detected, preventing the escalation of problems.

The training needs of quality inspection personnel in power plant installation and construction units cover aspects such as mastery of technology and standards, operational skills, safety awareness and emergency handling, as well as soft skills enhancement. Through precise needs analysis, a comprehensive and targeted training plan can be developed for quality inspection personnel, thereby improving the overall quality and efficiency of power plant installation and construction projects[2].

2.2. Innovative Training Models

In the training process for quality inspection personnel at power plant installation and construction units, traditional training models can no longer fully meet current needs. To enhance the practical effectiveness of training, it is necessary to explore and implement innovative training models. Here are several proposals for innovative training models:

2.2.1. Simulation Training

Application Scenarios: By establishing a virtual simulation environment for power plant installation and construction, quality inspection personnel can learn and practice in simulated construction scenarios. This method allows trainees to face various complex situations without risk, improving their ability to solve real-world problems.

Technical Implementation: Utilize Virtual Reality (VR) and Augmented Reality (AR) technologies to create highly realistic simulations of power plant equipment installation and quality inspection processes, including equipment operation, fault diagnosis, and repair.

2.2.2. On-the-Job Training

Training Mechanism: Directly assign quality inspection personnel to ongoing power plant installation projects for on-site learning and operation. On-the-job training allows quality inspectors to work alongside experienced engineers and technicians in a real work environment, learning practical skills and workflows.

Guidance System: Design a detailed guidance and feedback system to ensure that during the training period, quality inspection personnel receive effective guidance and supervision, allowing for timely correction of errors and reinforcement of learning.

2.2.3. Micro-Courses and Online Learning Platforms

Content Design: Develop a series of professional micro-courses covering all aspects of power plant installation and construction, including the latest industry standards, quality control methods, and safety operation procedures. The content should be concise and clear for quick learning and review.

Platform Application: Through an online learning platform, offer flexible learning options so that quality inspection personnel can study according to their own schedules. The platform should support interaction and discussion to encourage exchange and sharing among learners.

2.2.4. Case Analysis and Discussion

Case Repository Construction: Collect and compile typical cases from power plant installation and construction processes, including both successful cases and lessons from failures. Through detailed case analysis, enable quality inspection personnel to understand quality control strategies and methods in different scenarios.

Group Discussion: Regularly organize group discussion sessions, inviting experienced quality inspection experts to guide the analysis of problems in cases and discuss solutions. This interactive learning method can enhance the critical thinking and problem-solving abilities of quality inspection personnel.

These innovative training models aim to break away from traditional training frameworks, providing more diversified, interactive, and practical learning experiences. Not only can this enhance the professional skills and operational efficiency of quality inspection personnel, but it also strengthens their ability to handle real-world problems, thereby significantly improving the overall quality control level of power plant installation and construction projects.

2.3. Capability Assessment and Certification

In the training program for quality inspection personnel at power plant installation and construction units, establishing a scientific capability assessment system is crucial for ensuring training effectiveness and enhancing the professional level of quality inspectors. This system should aim to evaluate the improvement in capabilities of quality inspection personnel post-training through quantitative methods, and further motivate them to enhance their professional skills and work efficiency through a certification mechanism.

The construction of a capability assessment system should be based on the core competencies and job requirements of quality inspection personnel, clearly defining key competency indicators. These indicators should cover technical knowledge mastery, practical operational ability, problem-solving capability, and safety awareness. Specifically, this can be done through compiling standardized test banks, designing practical operation assessments, and conducting case analysis competitions. The test bank should include both theoretical knowledge and practical skills to comprehensively assess the professional knowledge level of quality inspection personnel; practical operation assessments focus on the on-site operational ability and practical application level; case analysis competitions effectively examine the comprehensive analysis ability and problem-solving skills of the personnel.

Quantitative assessment of training effectiveness should be achieved by setting clear evaluation standards and using a variety of assessment methods. During the assessment process, self-assessment, peer review, and mentor evaluations can be utilized to ensure the objectivity and comprehensiveness of the results. Additionally, the assessment of training outcomes should not only focus on the immediate performance of quality inspection personnel but also consider their long-term work performance and actual impact on the quality of power plant installation and construction, allowing for dynamic adjustments and optimizations of training content and methods[3].

The establishment of a certification mechanism based on the results of capability assessments is an important means of motivating quality inspection personnel to continue improving. This mechanism could include issuing professional qualification certificates to personnel who meet certain standards, providing promotion opportunities, and offering bonuses or rewards. The certification mechanism not only enhances the professional pride and sense of belonging of quality inspection personnel but also encourages continuous learning and improvement, cultivating more high-quality professionals for power plant installation and construction units.

Through such a scientific capability assessment system and certification mechanism, the training effects on quality inspection personnel can be effectively monitored and enhanced, further ensuring

the quality and safety of power plant installation and construction, and improving the professional level and work efficiency of the entire project team.

2.4. Organizational Structure Optimization

In the context of increasingly complex engineering projects and heightened project management demands, optimizing the organizational structure of the quality inspection units in power plant installation and construction becomes key to ensuring engineering quality and enhancing team efficiency. Common shortcomings in current quality inspection organizational structures include unclear role delineation, inadequate horizontal collaboration mechanisms, and insufficient incentive systems, all of which directly impact the effectiveness of quality inspection work and the motivation of inspection personnel.

To address these issues, the following optimization strategies are proposed:

Firstly, clear role delineation is the foundation of organizational structure optimization. Based on the specific characteristics and engineering needs of power plant installation, the quality inspection department should be subdivided into several core groups, such as raw materials inspection group, process quality control group, and final acceptance group, with each group responsible for quality inspection at different stages. This approach not only enhances work efficiency but also ensures that quality control at each stage is more professional and meticulous. Additionally, defining the collaboration mechanisms between groups and establishing fixed communication and reporting systems are crucial to ensure timely information transfer and rapid problem resolution.

Secondly, building an effective horizontal collaboration mechanism to strengthen cooperation both among different quality inspection groups and between the quality inspection department and other departments is vital. Through regular coordination meetings, joint inspections, and peer reviews, not only can information sharing and resource integration among departments be promoted, but also team cohesion and a sense of shared responsibility can be strengthened. Furthermore, exemplary cases and innovative practices arising from cross-departmental collaboration should be recognized and promoted to inspire more innovation and cooperation.

Lastly, establishing and refining team incentive mechanisms is an important aspect of optimizing the quality inspection organizational structure. Incentive mechanisms should include both material and spiritual incentives. Material incentives might be implemented through quality bonuses, selection and rewards for outstanding quality inspectors, aimed at boosting the work enthusiasm and quality awareness of inspection personnel. Spiritual incentives, on the other hand, focus on professional growth and team honor, such as providing support for career development planning, conducting skill competitions, and establishing honor rolls to enhance inspectors' sense of professional belonging and self-fulfillment.

By implementing the aforementioned organizational structure optimization strategies, the professional level and work efficiency of the quality inspection team can be effectively enhanced, thereby ensuring the quality, safety, and schedule efficiency of power plant installation and construction projects. This not only benefits the overall level of project management but also helps to strengthen the core competitiveness of the enterprise.

2.5. Career Development Paths

In power plant installation and construction units, designing a clear and attractive career development path for quality inspection personnel is crucial for enhancing team stability and attracting more exceptional talent. A career development path involves not only constructing a promotion system but also developing skills training and personal growth plans, aiming to provide a long-term development platform and a clear career direction for quality inspection personnel.

Firstly, the design of the promotion system should be based on the depth and breadth of professional knowledge in quality control and the enhancement of management capabilities. The promotion system could be structured from junior inspectors to senior inspectors, and then to quality group leaders and department managers. Each promotion level should clearly define the required capabilities, responsibilities, and performance indicators needed to ensure transparency and fairness in the promotion process. Additionally, specific skills training and assessment standards should be set for each level to ensure that inspectors continually improve their professional and management skills as they advance.

Secondly, skills training is at the core of career development paths. Power plant installation units should regularly organize professional skills training and continuing education to help quality inspection personnel continually update their professional knowledge and skills. This includes learning about the latest quality control standards, advanced inspection technologies, and quality management systems. Encouraging inspectors to participate in external professional training and technical seminars can enhance their industry perspective and innovation capabilities. Establishing a comprehensive skills certification system to assess and certify the professional skill levels of quality inspectors can motivate personal growth and enhance the overall professional level of the team[4].

Lastly, the creation of individual growth plans should align with the career goals and personal interests of quality inspection personnel. Through one-on-one career development consultations and planning, help inspectors clarify their career goals and develop specific plans and steps to achieve these goals. Additionally, provide opportunities for leadership training and management skills enhancement for inspectors who aspire to advance to higher managerial levels, unlocking their potential and providing avenues for upward mobility.

Through these measures, power plant installation and construction units can offer a comprehensive career development path for quality inspection personnel that includes not only promotion opportunities but also chances for skill enhancement and personal growth. Such a career development path can effectively enhance team stability, increase job satisfaction and belonging among inspectors, thereby improving overall work efficiency and project quality.

2.6. Cultural Development

In the team building of quality inspection units in power plant installation and construction, fostering and strengthening a quality-centric organizational culture not only significantly enhances team cohesion but also deepens quality awareness, fundamentally improving construction quality and work efficiency. Building a quality culture is a systematic project involving the shaping of organizational values, setting behavioral codes, and implementing daily management practices, aimed at integrating quality awareness deeply into the team members' mindset, influencing and motivating everyone's behavioral patterns.

Firstly, shaping a quality-centric set of values is the cornerstone of cultural development. This requires corporate leaders to convey through their actions and words that quality is fundamental to the survival and development of the business, making this concept the core of the team culture. By constantly reinforcing a quality-first value through internal presentations, training courses, and daily interactions, it becomes a common belief among the quality inspection team.

Furthermore, establish behavioral codes that align with the quality culture, providing guidance for the quality inspection team's actions. These guidelines should include commitments to quality, teamwork, continuous improvement, etc., clearly defining the behavioral standards and work methods team members should follow in their daily work. Through regular reviews and feedback mechanisms, ensure these guidelines are effectively implemented and adjusted based on actual situations to maintain their timeliness and effectiveness.

Additionally, by hosting quality-themed events, competitions, and recognition programs, stimulate team members' identification with and enthusiasm for the quality culture. For example, organizing quality knowledge contests, quality improvement case-sharing sessions, and recognizing individuals or teams who excel in quality performance can not only enhance team members' professional skills but also strengthen team cohesion and competitiveness[5].

Lastly, the effectiveness of cultural development lies in its deep resonance with team members and transformation into their voluntary actions. Therefore, integrate quality culture into daily management and operational processes, through establishing a comprehensive quality management system, optimizing work processes, enhancing work efficiency, etc., making quality culture a natural part of every team member's work. Additionally, through ongoing communication and feedback, collect team members' opinions and suggestions on quality cultural development, jointly promoting the deep development of quality culture.

By deepening the construction of quality culture, not only can the internal cohesion and quality awareness of the quality inspection team be significantly enhanced, but it also fosters individual growth and overall team development, creating greater value for the power plant installation and construction units[6].

3. Conclusion

This study conducted an in-depth exploration of training and team building for quality inspection personnel in power plant installation and construction units, proposing a series of innovative training models and team-building strategies. The research demonstrates that by implementing innovative training methods such as simulation training and on-the-job training, the practical operational skills and problem-solving abilities of quality inspection personnel can be significantly improved. Moreover, establishing a scientific capability assessment and certification mechanism has provided clear career development paths for quality inspectors, greatly enhancing their learning motivation and professional growth. Additionally, by optimizing organizational structures and strengthening the construction of a quality culture, not only has the team cohesion and quality awareness been enhanced, but a solid human resource foundation has also been provided for the successful implementation of power plant installation and construction projects. Overall, the training and team-building strategies proposed in this study have significant theoretical and practical implications for enhancing the professional capabilities and overall efficacy of quality inspection teams in power plant installation and construction units.

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