

## Innovation in Training Mode: the "Competence-Driven" Three-Phase Work-Study Pattern



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### ABSTRACT

The training mode of the "competence-driven" three-phase work-study pattern is aimed at training strategic technical engineering talent. Through design of the "learning-practice-assessment" three-phase work-study cycle, trainees' professional competencies as well as comprehensive competencies in character building, innovating, and management are enhanced. SINOPEC has explored three typical types of training under the pattern, namely "Focusing on fundamentals and practicing the basic skills", "closely integrating with production", and "integrating learning with research", and a trainee-centered, multipartite training ecosystem that is efficient and collaborative has been successfully established, effectively driving the learning to application transfer and solving the bottleneck that has long constrained training effects.

### Keywords

technical engineering talent, competence-driven, three-phase work-study pattern, training mode, training ecosystem, learning to application transfer

### INTRODUCTION

The "Three-Phase Work-Study" training Pattern started in SINOPEC Management Institute (hereinafter referred to as "the Institute") of China Petrochemical Group (hereinafter referred to as "SINOPEC"), as the Institute conducted training for catalytic cracking personnel of the refining sector in 1992. Since then, the pattern has been widely applied to training of many technical disciplines in various fields from petroleum exploration and production, to refining and chemical engineering, etc. The training pattern is highly technically characterized, aiming to enhance trainees' problem-solving competencies, and has cultivated a large number of technical engineering experts for SINOPEC. After a great deal of practice and exploration, the pattern was further improved and gradually evolved into a "problem-solution-oriented" three-phase work-study pattern for technical engineering training that has distinct petrochemical characteristics and is unique to the Institute, the three phases being "acquisition that aims for application", "Improvement by solving problems", and "merging by sharing".

"Acquisition that aims for application" refers to the process of knowledge accumulation,

during which 2-3 weeks of face-face learning are organized to systematically and comprehensively study relevant advanced theories and unique technologies aiming at typical problems in a specific field or discipline or complex problems that need to be urgently solved. "Improvement by solving problems" is the process of solving the problem(s), during which trainees bring the knowledge acquired back to their companies, and in 4-5 months, they carry out in-depth practice and research using the knowledge to try to solve practical problems in production. At the end of this phase, they have to compile a report, in which ideas and approaches to solve the problem(s) are put forward. "Merging by sharing" is a process of engaging and learning, during which trainees come back with the results of practice as well as any new problems encountered during the practice for a 1 week classroom training, in which industry experts are invited to attend, discuss, comment and exchange views with the trainees on their reports. Therefore, the "problem-solution oriented" three-phase work-study training pattern starts with the identification of the problem (s) and ends with resolution of the problem (s). It is a true portrayal of "trainees come with problems and go back with ideas to solve the problems." In 2010, this pattern was officially presented at the 11th IACEE World Conference.

## 1 Context

The oil price fluctuation in recent years has brought a huge impact to the conventional petrochemical industry. SINOPEC's corporate strategy during the "13th Five-Year Plan" has also undergone significant adjustments. In the upstream petroleum exploration and production sector, SINOPEC Oilfields face more and more complex geological conditions, the bottleneck constraints become more and more prominent, and the requirements for cost reduction are getting higher and higher. Pursuing "commercial discovery" and "efficiency first" has become top priorities under the increasingly difficult business environment. In oil refining, a combination of factors such as significant overcapacity at home and abroad, declining demand, and stricter safety and environmental protection requirements forces refineries to shift from the expansionist development of the past to a more qualitative development. In the chemical engineering sector, there exists serious production overcapacity. Shrinking profit margins, high staff turnover rate and lack of comprehensive competitiveness have highlighted the urgent need to nurture new profit growth to adapt to the new normal.

SINOPEC's new strategy of "focusing on improving quality and efficiency, optimizing structural adjustment, and promoting supply-side reform" puts forward new demands for personnel training, and correspondingly the Institute actively advocates innovation of training and sets as its goal to train high-quality strategic reserve talent "with a solid knowledge foundation, strong practical ability, strong comprehensive professional competencies, good business management and operation capabilities, and good ability at finding innovative solutions to problems". Under this context, the Institute, with the training philosophy of "starting with the ending in mind" and carrying out whole-process training design and implementation, innovatively proposes the "competence-driven" three-phase work-study pattern for technical engineering personnel training.

## 2 Scope

The training mode of the "competence-driven" three-phase work-study pattern is closely oriented around SINOPEC's strategic development needs, production problems and work tasks, and is aimed at training strategic technical engineering talent,. Through design of the "learning-practice-assessment" three-phase work-study cycle, trainees' professional competency as well as comprehensive competencies in character building, innovation, and management are enhanced, in an effort to better meet the technological, managerial and institutional innovation needs of SINOPEC.

The "competence-driven" three-phase work-study training pattern is different and a step further than the "problem-solution-oriented" training pattern in a number of ways: in the "learning" phase, the "competence-driven" pattern is not constrained to one single technological issue; while the "problem-solution-oriented" pattern stresses problem-solving, the "competence-driven" pattern stresses the strategic demands of the new era on the comprehensive competencies of technical engineering talent. Therefore the knowledge learnt in the former pattern should not only be proficient and meet present needs but should also be comprehensive, systematic and forward-looking. In the "practice" phase, the latter pattern stresses solving current practical problems in enterprises, while the former pattern takes as its goal to meet the needs of SINOPEC's recent strategic work tasks, embedding and integrating the strategically relevant and difficult problems of the new era into the learning process. In the "assessment" phase, the "problem-solution-oriented" pattern is more result-oriented, the criterion being whether or not the actual problems of enterprises are solved in the end. As solving production problems has time constraints, this pattern of training usually lasts 6 months. In contrast, the "competence-driven" pattern puts more emphasis on the process at the same time as it emphasizes results. During this pattern's one-year training period, through measures like process assessment, difficulties in implementation practice and new problems in production are discovered and timely incorporated into the next round of learning design. This shows that the three-phase multi-cycle design of "learning-practice-assessment" is comprehensive and focused, the method used is flexible and scientific, and it greatly improves the learning experience, complements and completes the professional knowledge structure of trainees, and at the same time it upgrades the trainees' comprehensive competencies, especially their hands-on capabilities and ability to innovatively solve practical problems. The pattern is in line with the growth path and development needs of technical engineering personnel. The seamless connection between "learning - practice - assessment" has given new meaning to the "three phase work-study" training pattern.

## 3 Training Practices

The "competence-driven" training pattern starts as an effort to meet the strategic needs of SINOPEC's different business developments. Correspondingly, the training also showcases the different strategic development features of different business sectors of SIOPEC Group. "Focusing on fundamentals and practicing the basic skills", "closely integrating with production ", and "integrating learning with research" are the three typical types of training that the Institute has explored under the pattern, providing talent support for SINOPEC's development in the next 5-10 years. .

3.1 The "competence-driven" and "Focusing on fundamentals and practicing the basic skills"

Pattern for Refining Process Strategic Talent Training

In the first year of the 13th Five-Year Plan, SINOPEC strengthened its "grassroots construction, basic work and basic skills training". In oil refining, a series of training courses that "focus on fundamentals and practice the basic skills" were held for young backbone technicians concerning core equipment in oil refining (such as those for catalytic cracking, hydrogenation, continuous reforming, atmospheric depressurization, coking, sulfur recovery, and other devices).

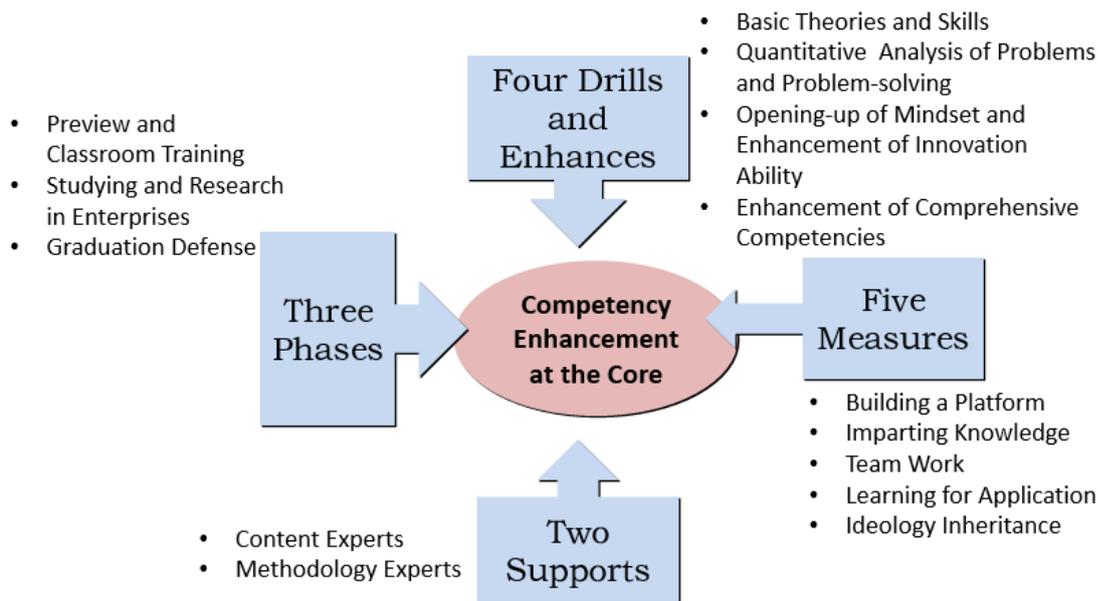


Figure 1 The "competence-driven" and "Focusing on fundamentals and strengthening three basics" Pattern for Refining Process Strategic Talent Training

This talent cultivation pattern can be summarized as "one core, one support, three phases, four drills and five measures" (Figure 1): "One core" means to improve the trainees' theoretical and engineering calculation ability, as well as their abilities to quantitatively analyze the problems and to innovatively solve problems, with the goal being to cultivate refining experts for SINOPEC. "One support" refers to the full support of a top expert team. The experts lead the trainees to attend lectures, seminars and surveys, guide them through the whole process of assignments and research reports. They conduct their learning and research in line with the scientific and pragmatic philosophy of "not just books, not just teachers, but only truth in the end". "Three phases" is a three-phase cycle design of "learning-practice-assessment" for each core competency. Taking the "The Training Program for Upgrading the Theoretical and Engineering Computing Power of Process Technicians in Refining Core Equipment" as an example, the trainees studied the basic theory of refining core equipment and device reaction mechanism. The trainees also carried out engineering computing drills for the three major balances (material, heat and pressure) and the three engineering processes (fluidization, reaction, catalyst application) of SINOPEC core refining equipment. After technical analysis, the trainees identified the problems that occurred in the calculation process, and prepared and submitted a solution proposal to the expert team for assessment. In this training, refining production provides a real platform for the trainees to transfer learning into application. "Four drills" refer to the above-mentioned engineering computing drill, quantitative analysis drill of problems, etc., with major

assignments and periodic testing for the trainees throughout the process. "Five measures" refer to the five learning pathways of building a platform, imparting knowledge, team work, learning for application, and ideology inheritance.

The "competence-driven" and "Focusing on fundamentals and practicing the basic skills" Pattern for Refining Process Strategic Talent Training provides strong talent support for the long-term, sustained development of SINOPEC Refineries. In the past three years, production has been expedited of a large number of products urgently needed in the market, the number of unplanned downtime has been reduced by three-quarters, and the competitiveness and profitability of the refining enterprises have been greatly enhanced.

### 3.2 The "competence-driven" and "closely integrating with production" Pattern for Cultivation of Comprehensive Talent in Refining Equipment Management

The Training Program for Comprehensive Talent in Refining Equipment Management aims to cultivate a batch of advanced comprehensive talent who understand technological management and who can make equipment decisions in the next 5-10 years. Before the training, the trainees generally lack in the required knowledge structure as well as operation and management capabilities. The one-year training and "learning-practice-assessment" three-phase work-study design not only significantly enhance the comprehensive competencies of trainees, but also greatly improve the work of a series of major equipment inspections across SINOPEC Group.

In the "Learning" phase, the trainees' relatively simple knowledge structure, i.e. having sufficient in-depth knowledge of certain equipment but inadequate general knowledge of equipment management, is addressed. Under the new strategy of "building a world-class level of refining and petrochemical equipment management ", with the large-scale and diversified types of refining and petrochemical enterprises, and as new equipment and technologies continue to emerge, there is an urgent need for the equipment management talent to learn a large number of theories and get familiar with the rapidly expanding equipment types.

The training adopted the measures of "three learnings and three lectures" and "two questions and two forums" to emphasize knowledge input, output and re-processing. The "three learnings and three lectures" refer to learning of principles, methods, and cases, and lectures on accomplishments, suggestions and experiences, and the "two questions and two forums" refer to trainee and trainer questions, as well as trainee and expert forums. In the "practice" phase, link with the core business of SINOPEC is sought after proactively to provide real application opportunities for the trainees. For example, after receiving a one-month systematic training on the technical and management theories of the maintenance of electromechanical and static equipment, trainees are transported to the overhaul of the Yangzi Petrochemical Plant to participate in the decision-making of overhauling solutions and guide the overhaul at the worksite. For another example, after receiving a series of intensive training on equipment system standards, the trainees are promptly sent to the frontline of SINOPEC's Company Equipment Inspection to complete real tasks and bear real responsibilities. "Assessment" is conducted after each stage of learning and practicing tasks, in which the trainees will submit the results to be evaluated by SINOPEC Group and the expert team. At the same time, the training team utilizes procedural assessments and expert feedback to timely provide new learning content and set up new learning environments for the trainees. For example, at the latter stages of the training, trainees are sent again to help with projects in Shijiazhuang for further accumulation of experience and abilities.

The "competence-driven" and "closely integrating with production" Comprehensive Talent Training Program for Refining Equipment Management supports SINOPEC's safe and stable operations of various equipment. Taking the overhaul of Yangzi Petrochemical Plant as an example, a total of 56 sets of equipment were overhaul in 2 months, and 5,143 overhaul projects were carried out. During the period, solutions were proposed targeting seven issues, such as prevention of coking of catalysis, Butadiene compressor GB1101 oil leakage, 1 # Ethylene GB501 separator scouring, cracks on the outer surface of PE / PP equipment pipes, etc., and 34 inspection suggestions are put forward. The three-phase work-study "Learning-Practice-Assessment" design of the training reinforces the absorption of knowledge, quickly transferring learning into application and productivity.

### 3.3 The "competence-driven" and "integrating learning with research" Pattern for Synthetic Resin Plant Experts Training

Under the new normal of economy in China, SINOPEC has certain advantages in its synthetic resin business, but it is still under great pressure to adjust its product structure. At present, the development of high-end synthetic resin products is still not optimal, accounting for one-third of all production. And for a long time, the high turnover of synthetic resin professionals makes the talent team unable to meet SINOPEC's current reform and development needs. How to continuously innovate and develop under the new normal to achieve sustainable development is a serious problem faced by the chemical engineering industry. The Synthetic Resin Plant Expert Training Program is designed to train high-level polyolefin equipment experts who possess strong innovation ability, organization and management skills, and ability to solve practical problems, and who are proficient in production technology and agile to the work demands of "production, marketing, research, application". This serves as an effort to meet SINOPEC's strategic requirements in the new era of "quicken new product development" and "accelerating the training of comprehensive synthetic resin professionals".

The Training program puts "new product development" as the ultimate goal throughout the entire learning process, strengthening the "starting with the ending in mind" training concept: the training embeds the knowledge and technological skills needed in new products development in the "learning-practice-assessment" training design, and through the development of new products at the end, the trainees' comprehensive competencies are enhanced (Figure 2). For example, in the "learning" phase, trainees need knowledge and

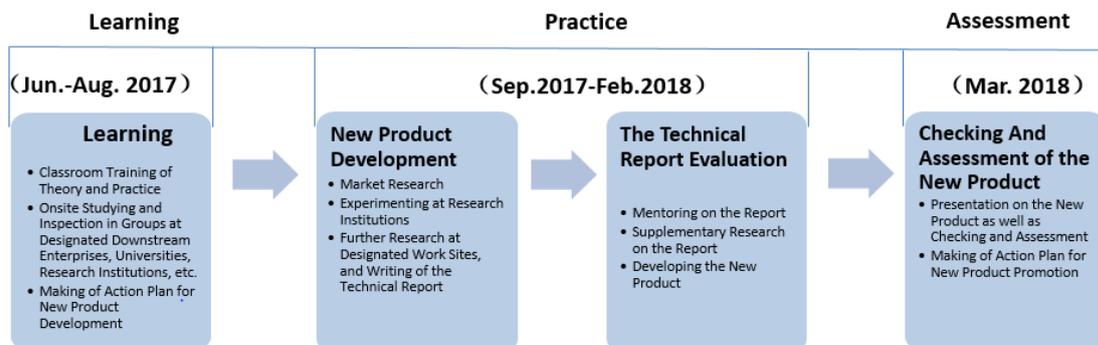


Figure 2 The "competence-driven" and "integrating learning with research" Training Pattern for Synthetic Resin Plant Experts

technological theories concerning polymerization reaction principle, process calculation and

simulation of the catalyst and polyolefin, additives, etc. They also need knowledge about the complete chain of new products development from the recipe, to process simulation, trial production, testing, to post-processing and customer service.

In the "practice" phase, that is, during the development of new products, trainees need to understand the real market demand. The trainees are brought into the lab and the field as they are the adequate platform for new products development. Process assessments timely provide counseling for the trainees, until successful development of the new products, which are evaluated in the "assessment" phase. The "competence-driven" and "integrating learning with research" pattern for synthetic resin plant expert training on the one hand enhances trainees' competencies through new products development; on the other, it also develops new products to meet market demands.

## **SUMMARY**

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The "competence-driven" three-phase work-study training pattern is a breakthrough in the training of strategic technical engineering personnel. In its continuous exploration and practice, the Institute conscientiously studies professional growth of technical engineering personnel, while actively seeking to influence business departments of SINOPEC Headquarters, direct subsidiaries under SINOPEC and industry experts using most advanced training philosophies, techniques and methods. As a result, leaders from headquarters and business departments are actively engaged in the training process of pre-training needs analysis and program design, during-training training-program opening, teaching, and research. The subsidiary companies are encouraged to provide the right platform and environment for the trainees to transfer learning into application, by proposing training objectives before the training, supervising trainees during the training and providing performance support after the training. By signing hiring contracts with expert teams, their strong technical support and guarantee is ensured. Through whole-process training design, fine implementation during the training and follow-up assessment after the training, the trainees are guided to fully participate in the strategic tasks of SINOPEC to ensure effectiveness of the training.

Over time, an efficient and collaborative training ecosystem has been successfully established that is trainee-centered and that incorporates different stakeholders and role-players including SINOPEC Headquarters leaders, business departments, direct subsidiaries, the Institute, and expert teams composed of members from within and outside of SINOPEC Group. The ecosystem effectively drives the learning to application transfer and solves the bottleneck that has long constrained training effects.