Competency Enhancement Model of Physical Infrastructure and Asset Management in Compliance with PAS-55 for Hong Kong Automotive Manufacturing Engineers

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Abstract To cope with the pitfall induced by the quick growth rate in asset management of automotive components manufacturing, an industry-wide professional competence development programme was initiated by SAE-HK and implemented by HKPC to upgrade the production and engineering asset management capability of Hong Kong automotive manufacturing engineers in order to boost the overall operation quality and efficiency of the industry. Through the comprehensive programme including the formulation of a human resources competence model for the industry, identification of major facility engineering and optimization tools in PAS-55 including Condition Assessment Technique (CAT); Machine Capability Index (MCI), Maintenance Analysis and Management (MAM) and Facility Management Information System (FIMS); PAS-55 system trial run and tools application at pilot companies; and the compilation of a best-in-class training and PAS-55 system implementation manual, local automotive component engineers are practically equipped with appropriate tools to understand the risks their businesses face, and the factors associated with facility optimization and prioritization.

Keywords PAS 55 · Human resources development · Hong Kong automotive manufacturing engineers

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P.W. Tse et al. (eds.), *Engineering Asset Management - Systems, Professional Practices and Certification*, Lecture Notes in Mechanical Engineering,
DOI 10.1007/978-3-319-09507-3_63

1 Introduction

1.1 The Chinese and Hong Kong Automotive Manufacturing Industries

Through years of double-digit expansion, Mainland China surpassed Japan to become the largest car producer in 2009 and the current Chinese market size is almost twice the size of the USA or Japan, far larger than any European country. Yet, the growth potential is still enormous as still less than 5 people in 1000 own an automobile. According to the China Association of Automobile Manufacturers, the overall automobile sales in Mainland China is expected to increase by 7 % to 20.6 million in 2013, safely securing her rank No. 1 in the world [1].

While the Chinese automotive industry and market grows by leaps and bounds, Hong Kong automotive components manufacturers have grasped a golden chance of enhanced special access to the high potential market in the light of CEPA and WTO commitments. The strong growth of the Chinese market has been leading the growth of the Hong Kong automotive industry, giving to the rise of a number of Hong Kong automotive manufacturing enterprises through the advancement in technological competence and the business scale.

1.2 More Than Fundamentals—Physical Infrastructure and Asset Management

According to Mr. Gordan Chan [2], ex-president of the Hong Kong Auto Parts Industry Association, in 2007 the Hong Kong automotive manufacturing industry consisted of 400-odd enterprises, of which about 30 were considered as "tier-one" which directly deal with high-end car manufacturers, while the remaining "tier-two" and "tier-three" operated in an OEM capacity. However, no matter the size and position of automotive manufacturers along the automotive supply chain, all suppliers have to get over dozens of stringent technical requirements on safety, reliability and product quality set by the automotive manufacturers and the upper tier customers to gain the entry ticket within the automotive manufacturing industry.

Through traditional engineering training, Hong Kong engineers are technically fit in automotive engineering, manufacturing engineering and facility design. However, inadequate training on equipment and machinery maintenance in traditional engineering disciplines could lead to incredibly increase in tools replenishment and equipment maintenance cost, extraordinary quick deterioration of working environment and potential pitfall in non-compliance with the requirement on Infrastructure Management and Work Environment Management stated in ISO/TS 16949, also the expectation of automotive manufacturers and upper tier customers.

1.3 PAS 55 and Asset Management Under the Spotlight

PAS 55 has been widely recognised as a significant step on the road of asset management. Many organisations and companies worldwide showed their interest in developing the specification and are actively wide spreading its use within the organizations. With the help and guidance of PAS 55, the Hong Kong based China Light and Power reported a 90 % reduction in system losses, while meeting a 20 % growth in demand and reducing customer charging tariffs by 40 %. Due to the ever success of PAS 55, the International Standards Organisation (ISO) has accepted PAS 55 as the basis for the development of the series of international standard ISO 55,000, which turns the best practice on asset management internationally for global excellence enhancement.

PAS 55 is a general standard for managing physical assets which is particularly relevant. It is deliberately structured to follow the design of other international standards including ISO 9000 and the Deming Plan-Do-Check-Act cycle of continual improvement. It also introduces the need for a number of essential tools to ensure alignment, integration and sustainability of efficient and effective asset management activities.

In 2008, PAS 55 was updated with input from 50 organizations in 10 countries, representing 15 industry sectors. It is increasingly recognized as a generically applicable definition of good practices in the whole life cycle, optimized management of physical assets. Comprising two parts, Part 1—Specification for the optimized management of physical infrastructure assets and Part 2—Guidelines for the application of PAS 55-1, it offers a 28-point checklist of requirements for an effective asset management system, defined terms and practical guidance on the implementation of the standard [3, 4].

2 Industry-Wide Human Resources Analysis and Enhancement

2.1 Urgent Needs of the Hong Kong Automotive Manufacturing Industry

ISO/TS 16949 has not been new to the Hong Kong automotive components manufacturers since 2002. The Hong Kong automotive manufacturing sector grows very quickly due to the growth of the Chinese market with the tangible support from the HKSAR Government. To keep the ball rolling, automotive components manufacturers must have effective management processes to maintain the high quality and reliable automotive components at a competitive cost, which is primarily dependent on the effective function of their manufacturing facilities and the stewardship of the physical assets such as production equipment, manufacturing

plant, auxiliary peripheral equipment, testing facilities, logistic facility, software programmes and system back up, etc.

According to the requirement of ISO/TS 16949, manufacturers shall determine, provide, and maintain the infrastructure needed to achieve product conformity and require a formal approach for infrastructure and facility management including contingency plan. Therefore, formal approach is explicitly required to infrastructure and facility management for automotive component manufactures in order to meet industry expectation. With a formal facility management system in place, automotive components manufacturers would be able to better understand the risk that their businesses face and factors associated for facility optimisation and prioritisation in order to achieve mutual benefits.

2.2 Human Resources Analysis and Modeling

To satisfy the industry's needs and to cope with the abovementioned problems, SAE-HK proposed an industry-wide professional competence development programme with Hong Kong Productivity Council (HKPC) to seek governmental funding support through the Professional Services Development Assistance Scheme (PSDAS) from the Commerce and Economic Development Bureau (CEDB). The proposed professional competence development programme targeted mainly on automotive manufacturing engineers; starting with the desktop search and analysis of the capability of human resources on asset management, and following by sample forms and tools design, train-the-trainers programme, practical on-site implementation trials, industry-wide enhancement training and training manuals compilation.

The human resources capability desktop search and analysis indicates the direction and the framework of the entire project. The aim of this phase is to identify the skillset of engineers within the automotive manufacturing sector based on the traditional engineering training at universities and technical colleges. Based on the results, the main targets of the professional competence development programme are identified. The results of the study of skillsets possessed by engineers from different engineering disciplines within this sector are shown in Fig. 1.

The automotive manufacturing sector is very closely linked with manufacturing engineering and mechanical engineering which focus on automotive parts and components design and manufacturing processes. These were the major revenue-generating areas where Hong Kong manufacturers focused on. Computer engineering and information engineering serve mainly as a business supporting role in the field of information technology within the sector, while civil engineering and electrical engineering and for the construction of manufacturing infrastructure and plant construction. Electronic engineering is the least relevant as the production of automotive signaling systems or other electronic automotive control systems are not typical to Hong Kong automotive manufacturers.

Fig. 1 Technical knowledge and skillset profile analysis for engineers from different engineering disciplines within the automotive manufacturing sector

Therefore, the main participants of our programme were automotive manufacturing engineers from the manufacturing and mechanical engineering background who had extensive exposure to expensive production equipment and necessary physical infrastructure. The programme structure was then formulated in accordance to their skillset they built up from traditional engineering training and the gap between the world class asset management best practice.

2.3 Comprehensive Series of Professional Competence Development Programmes

In the traditional manufacturing engineering and mechanical engineering training, the provision of courses on asset management and other similar subjects is comparatively generic and theoretical. There is no practical training on asset management for the automotive manufacturing sector offered by any local engineering institutions. Seeing this, 13 topics were chosen based on the human resources capability analysis to provide a comprehensive understanding on PAS 55 for the

Table 1 The training series within the professional competence development programme

Module	Topic
M1	Understanding of PAS-55 optimized facility management
M2	Facility engineering and optimization tool on life-cycle cost analysis (LCCA)
M3	Facility engineering and optimization tool on demand forecasting and management (DF&M)
M4	Facility engineering and optimization tool on machine capability index (MCI)
M5	Facility engineering and optimization tool on condition assessment and performance monitoring (CAPM)
M6	Facility engineering and optimization tool on risk assessment and management (RAM)
M7	Facility engineering and optimization tool on optimised decision-making (ODM)
M8	Facility engineering and optimization tool on maintenance analysis and management (MAM)
M9	Facility engineering and optimization tool on facility management information system (FMIS)
M10	Facility engineering and optimization tool on internal audit of risk-based management system of PAS55
M11	Facility engineering and optimization tool on facility management information system (FMIS)
M12	Facility engineering and optimization tool on documentation Development for facility management system
M13	Facility engineering and optimization tool on continual improvement

automotive manufacturing engineers. The details of the training series are shown in Table 1.

The first part of the training series was to train the trainers. 25 local engineers were identified and selected as the participants in the train-the-trainer section to learn the theories behind the asset management tools and to obtain practical knowledge on the application of asset management tools. The participants were then required to trial apply the facility engineering and optimization core tools on-site in their own factories so as to obtain hands-on experience. Then the 25 local engineers held the training sessions, with all 13 modules inclusive, in Mainland China to transfer their knowledge and share their experience to 75 Hong Kong engineers stationed in Mainland China.

Sample forms and tools were provided to facilitate the lectures and a practical session was arranged so that they could use the tools and knowledge in actual situations. All the course contents and the sample tools were compiled in the implementation manual to enhance the efficiency and effectiveness of knowledge transfer. One of the sample designed is shown in Fig. 2 and the cover of the implementation manual is shown in Fig. 3.

設備潛在失效模式及效應分析 (MFMEA)

__ 系統 _____ MFMEA 編號 _____

__ 次系統 _____ 頁數 第___頁，共_____頁

__ 零組件 _____ 設計責任 _____ 編制人 姓名_____ 部門_____ 職員編號_____

產品型號/計劃代號 _____ 關鍵日期 _____ DFMEA日期 (初稿)_____ (修訂)_____

跨部門小組 _____

項目 / 功能	潛在失效模式	潛在失效之效應	嚴重性	等級	潛在原因/失效機制	發生頻率	現行設計控制		難檢度	風險優先數	建議行動	責任與目標完成日期	行動結果			
							預防性	採測性					已採取行動	嚴重性	發生度	難檢度	風險優先數

Fig. 2 Sample form for MFMEA [5]

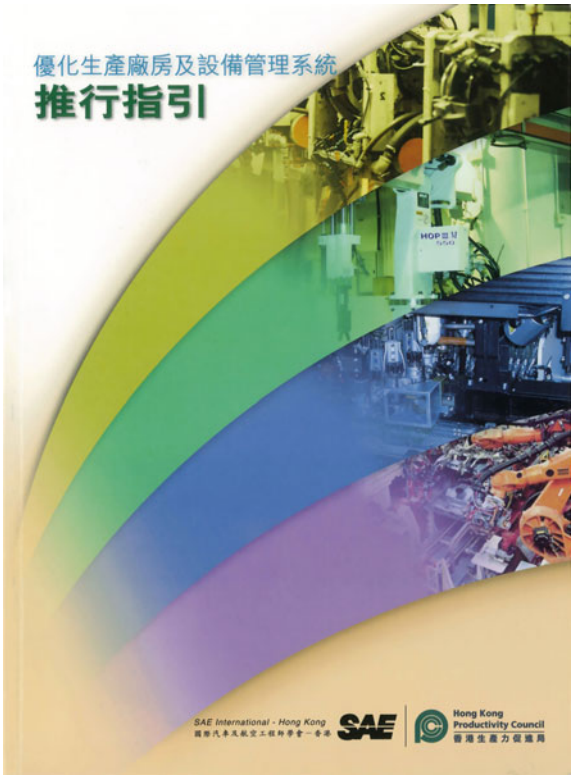

Fig. 3 The cover of the implementation manual [6]

3 Discussion

3.1 Effectiveness of the Professional Competence Development Programme

After the 28.5-day training series, the local automotive manufacturing engineers participated in the programme had shown their competence on PAS 55 through the successful application of various technical tools on asset management and the holding of teaching sessions in the PRD region. Apart from the direct beneficiaries at a size of 25 locally trained trainers and 75 Hong Kong engineers stationed in Mainland China, over 1300 engineers were benefitted by the implementation manual which contained the implementation guide, the set of sample facility engineering and optimisation tools as well as the set of PAS 55 process-based procedures.

3.2 Seed Driving Force of the Application of the Best Practice

Before the local trainers held their sessions in the PRD region, they had to trial implement PAS 55 according to the tools and skills taught during the lectures held by overseas speakers. The application skills were well proved to be practical and applicable through the two training sessions, which was commented as a very good arrangement for the local trainers to practice the newly learnt skills in the industry. From the attained performance of the local automotive manufacturing engineers, they could surely become the driving source to fasten the advancement of the industry through local knowledge sharing.

4 Conclusion

Within the automotive manufacturing industry, it has been conjoining, banding to pool resources since 1996 [2] The extensive growth in size and technology level requires high level on asset management, which is exactly addressed by PAS 55. In the foreseeable future, the development trend within this industry will drive a ballooning need for talents with PAS 55 or relevant asset management knowledge. The professional competence development programme showed successful knowledge transfer not only from the overseas speakers to the Hong Kong automotive manufacturing engineers, but also from these trainers to those engineers stationed in Mainland China. Through the provision of sample forms and tools specified in PAS 55, the trained engineers could pick up the skills on asset management quickly and able to apply those skills in actual situation. It is hoped that programmes in similar structures could be held in other industries so that the professional asset

management knowhow could widely be spread amidst Hong Kong industries, well supporting the growth of the industries grasping the golden chance provided by the Mainland market.

References

1. Russell F (2013) China's auto sales to rise by 7 % to record in '13, industry group says. Forbes: staff. http://www.forbes.com/sites/…/chinas-auto-sales-to-rise-by-7-to-record-in-13-industry-group-says/
2. The Federation of Hong Kong Industries (2007) Hongkong Industrialist. Hong Kong, China, pp 14–23
3. The Institute of Asset Management (2008). PAS 55-1:2008 asset management part 1: specification for the optimized management of physical assets. British Standards Institution, UK
4. The Institute of Asset Management (2008) PAS 55-1: 2008 asset management part 2: guidelines for the application of PAS 55-1. The British Standards Institution, UK
5. Hong Kong Productivity Council (2009). 優化生產廠秀及設備管理系統推行指引. Hong Kong, China, pp 2–30