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## Managing lean capabilities through flexible workforce development: a process and framework

Kim Hua Tan<sup>a\*</sup>, Paul Denton<sup>b</sup>, Rosalind Rae<sup>c</sup> and Leanne Chung<sup>d</sup>

<sup>a</sup>Nottingham University Business School, University of Nottingham, Jubilee Campus, Nottingham, NG8 1BB, UK; <sup>b</sup>School of Computing and Engineering, Huddersfield University, Huddersfield, UK; <sup>c</sup>Aberdeen Business School, Robert Gordon University, Aberdeen, UK; <sup>d</sup>Cardiff Business School, Cardiff University, Cardiff, UK

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Many firms today are employing temporary contractual workers in order to help them to stay lean and flexible. The benefit of this approach is that the process of layoff is much easier. Thus, an emerging issue arises here, on how can firms manage and train temporary workers effectively? The core of lean adoption is through people, to have workers buy into the ideas and be part of the overall initiative. There is very little guidance available on how to deal with contractual workers who have less motivation and commitment to the firm given that they are only employed on a temporary basis. This article proposes a framework and process to assist firms in managing and training temporary workers to improve the efficiency and effectiveness of the implementation of lean improvement initiatives.

**Keywords:** flexible workforce; lean management; contract worker; manufacturing flexibility; core–peripheral model

### 1. Introduction

Due to intense market competition, firms are increasingly adopting lean manufacturing practices in order to improve their competitiveness through increased flexibility, lower costs and improvement in product quality. Successful lean implementation requires effective training approaches (Suzaki 1987, Womack and Jones 1994, Kabst *et al.* 1996, Liker 2004, Ozelkan and Galambosi 2009, Rother 2009, Tan *et al.* 2010, Angelis *et al.* 2011, Hodge *et al.* 2011). The contribution of workforce training to organisational performance improvement cannot be overstated. Training is necessary in order to develop a workforce which is capable of shouldering the increased responsibility, which is required to develop multi-skilled workers to create an environment in which workers have the skills and ability to push for continuous improvement (Boyer 1996).

Companies are looking for more and more innovative ways to use the most expensive item of variable operating costs, labour, in the most cost-effective manner (Jensen 2000, Riding and Mortimer 2002, Pennathur and Mital 2003, Krishnamurthy and Suri 2009, Stevenson *et al.* 2009). One of the major challenges faced by practicing operations managers in recent years has been the problem thrown up by extensive use of flexible labour. Brewster *et al.* (1997)

said that ‘flexibility created problems that needed to be addressed much more coherently and systemically by employers and a much more strategic approach adopted’. Pollert (1988) supports this view by stressing that the flexible firm model (also known as the core–periphery model) ‘fails to address the problems of control, efficiency and costs of fragmented market relations’. Kalleberg (2001) identified that little is known about the relative costs and benefits associated with organisations pursuing numerical or functional flexibility or a combination of the two. Many firms today are employing temporary contractual workers in order to help them to stay lean and be flexible. A flexible workforce is achieved through the use of temporary contracts to meet short-term demand fluctuations in production volumes. It also has the ability to reduce fixed labour costs and to enable the organisation to access services which can be difficult to secure through permanent employment contracts (Storey *et al.* 2002, Stratman *et al.* 2004). Thus, an emerging issue arises here, how can firms manage and train temporary workers effectively? The core of lean adoption is through people, whereby the aim is to achieve buy in from the workers into the ideas and be part of the overall initiative. Existing literature focuses mainly on training models for MNCs or established firms that have systematic training programmes

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\*Corresponding author. Email: [kim.tan@nottingham.ac.uk](mailto:kim.tan@nottingham.ac.uk)

in place. The training process may include Self-Directed Teams, 5S, Pull versus Push concept and Kaizen Blitz activities (Shingo 1989, Shah and Ward 2003). This can assist in the integration of lean principles and processes into everyday thinking and work practices. Limited research is available on how to deal with contractual workers who have less motivation and commitment for contributions given that they are only employed on a temporary basis (Brewster *et al.* 1997, Storey *et al.* 2002, Stratman *et al.* 2004). This trend is increasingly clear as the enlargement of the European Economic Community (EEC) has attracted many low-paid workers from Eastern European countries to work in traditional EU countries like the UK, France and Germany.

This article proposes a framework and process to assist firms in managing and training temporary workers to enhance the efficiency and effectiveness of the implementation of lean improvement initiatives. This article has five sections. Section 2 explains the flexible firm concept. Then, the challenges and issues in training temporary workers are described. Next, current training approaches and models are explained and the shortcomings are identified. A framework and process is then proposed. Its applicability and feasibility are explained in a case study. Finally, the research implications and directions for future research are discussed.

## 2. Flexible firms

Atkinson (1984) first introduced the concept of the core-periphery model through interest generated in opportunities for introducing new methods for labour organisation. The aim was to look at ways to loosen the contractual relationship between the employer and the employee. The main benefit was to reduce costs through a reduction in overtime and in overheads, but it was recognised at the time that it would throw up some new challenges, namely the issue of managerial control, teamwork and job security. The research was aimed at exploring the range of issues raised by shifts in labour inputs towards greater flexibility and the implications for employers and employees and the potential for further change. The labour force was becoming increasingly peripheral (therefore not core to the organisation) and more numerically flexible (the number of workers increases or decreases and/or the number of hours, depending on what the demand dictates).

The model assumes that the labour workforce is made up of a core group of employees which carry out firm-specific activities key to the organisation.

The core group is required to have functional flexibility (able to carry out different tasks, therefore effectively being multi-skilled). The core workers are full-time and permanent with prospects for a career. The central characteristic of the core group is that they are assumed to have the skills and experience specific to the firm which cannot readily be bought in. The core group of employees is in turn surrounded by a peripheral group of employees (Figure 1). The peripheral workforce would protect the core workforce from numerical employment fluctuations whilst conducting non-specific and subsidiary activities. As the market grows, the periphery would expand to take up the slack, as growth slows the periphery would contract. At the core, only tasks and responsibilities change. The peripheral workforce is likely to have jobs that are de-skilled and non-specific to the firm, functional flexibility is not required in the peripheral workforce. The peripheral group of workers is designed to maximise flexibility whilst minimising commitment to the worker. Part-time and short-term contracts are examples of this. The model has an external group which entail jobs which are either specialised or very mundane, subcontracting and temporary help agencies are examples of the work groups here.

Atkinson recommended that firms would need to decide for themselves the most appropriate formations of core and peripheral groups and to implement the right resourcing strategy suitable for the firm. Employment terms and conditions should reflect and encourage the fulfilment of that strategy. Atkinson (1985a) surmised that this would require management to develop different styles for each segment to get the most out of them.

The prediction was that the impact of such employment strategies would divide opinion within the workforce due to the differences in employment conditions, job security and promotion prospects between the core and peripheral workforces. Another important factor to achieve flexibility was alignment with the objectives of the firm. The challenge would be to decide what the precise configuration of the workforce needed to be to achieve the firm's goals and in turn this would require new methods of recruitment, selection, training and severance. Atkinson's research did not find evidence that firms were seriously addressing any of these issues.

The research did not make clear, under what conditions an ideal configuration of the workforce would look like. Questions left unanswered were: 'How could a firm achieve a cost-effective and productive operation through effective use of its core and peripheral workforce?', 'What would be the best balance for that operation?' and 'How would the ideal mix be

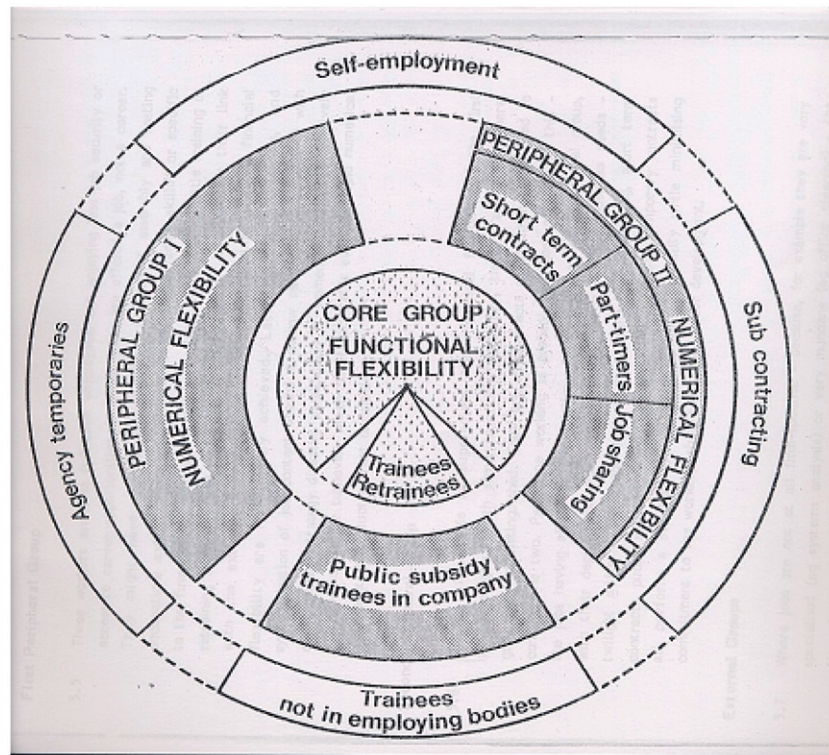


Figure 1. The core-periphery model (Atkinson, J., 1984. Flexibility, uncertainty and manpower management, IMS Report No. 89. Falmer, Brighton: Institute of Manpower Studies, University of Sussex. Copyright IES. Reproduced with permission).

achieved – by trial and error? Two key issues were identified which managers face when implementing labour force flexibility initiatives. There was a requirement to decide which functions and activities would be best suited for using some sort of flexible labour, if indeed certain working practices could be attributed to certain functions and activities. Also, appropriate processes and styles of management would need to be identified for each group for effective use of these different workforces. The pursuit of flexibility has implications across the board. Atkinson (1985b) predicted that the impact on the workers would be substantial and not necessarily positive. The firm which responds most readily to structural change is most likely to deploy a whole range of contractual, occupational and working time combinations in its workforce. It will be the organisation that recognises where and how it can best use peripheral labour and attract such labour in the quantities and qualities it needs that will gain the greatest advantages from these types of arrangements. The organisations that constructively use peripheral labour to achieve a secure and productive core group, rather than simply seeking to cut short-term costs, will be the ones that are most successful at managing and getting the best out of a flexible labour force. These will be the essential

conditions for success in uncertain and shifting markets, argued Atkinson (1985b).

Pollert (1988) was the main critic of the model and stated that it breaks down in its ability to offer practical policy advice for firms which it claims it does. It is vague in the ways in which firms might pursue flexibility. Moreover, it neglects counterproductive effects of adopting flexible working practices and future long-term implications. The model passes over the problems of co-ordination and control. At worst, Pollert argues that the model may lead to firms concentrating on the wrong issues and to adopt policies which have undesirable side effects. The model also fails to tackle the trade-offs faced when deciding to utilise peripheral workers – the trade-off between cost-cutting versus quality and a low-paid, casualised work-force versus investment in human capital. In other words, the creation of an insecure, untrained workforce is not presented as a problem which management needs to do something about.

Brewster *et al.* (1997) found that the adoption of flexible working arrangements was increasing through research undertaken in 14 European organisations. There was a significant increase in service organisations who were adopting flexible working practices more associated with manufacturing organisations



(shift work, 24/7 working, for example). Some of the potential organisational benefits of adopting flexible working practices, in particular, for temporary contract workers are as follows:

- an available pool of labour which is not on the headcount;
- only employ labour when there is a requirement;
- less long-term financial commitment;
- can terminate the contract as and when needed.

Some of the potential organisational challenges are as follows:

- integration within the workforce can be difficult;
- lower skills and knowledge level;
- no long-term commitment to the organisation;
- higher turnover of staff and therefore higher training costs.

### 3. Training challenges

Although Atkinson's model has its shortcomings, the core-periphery model is widely adopted in practice. Many companies now make a distinction between their core and non-core staff (flexible workforce). Shorter employment tenures tend to be associated with lower levels of training, which in turn, may have negative implications for the broader competitiveness of a firm and its long-term capacity for growth. First, if a large proportion of a firm's workforce believes that it is expendable and may shortly be made redundant, it is postulated that their commitment will be less than wholehearted. In particular, they are unlikely to bring their imagination and enthusiasm to the job. Second, if firms define their core competences too narrowly and assume that they can fish at will in a skill pool replenished by others, they may find themselves caught with an empty net, just as the time when markets are growing (Industrial and Commercial Training 1995). Moreover, workers in contrast, may decide that it is in their interests to ensure that their training is as broad as possible. They must work on employability and avoid becoming entrapped in a single-company cocoon. There is, therefore, a tension between employers and employees in this changed environment. Clearly, a more flexible labour market needs a more flexible training strategy (Hunter *et al.* 1993).

For successful lean implementation, many researchers (Ichimura and Arunachalam 2006, Ben-Tovim 2007, Brandao de Souza and Pidd 2011, Timans *et al.* 2011) propose that there are three main

requirements of workers: (1) flexibility and multi-skills; (2) team work and (3) motivation. This leads to the question of 'how can firms instil these values in temporary workers through training?'. Training is only half the battle. Low salaries pose a second hurdle for management. Even with good training, how can the firm retain and motivate workers, who are often working for the minimum wage? (Burt and March 1990). In general, there are a number of issues when addressing training for temporary workers:

- *Turnover.* Temporary workers are subject to layoff and rehire as the workflow changes depending on the job and therefore they will only carry out the minimum requirements of the job. Will it increase training costs through high turnover of new workers? Also, the loss of knowledge and skills is an issue, as higher turnover rates magnify the impact of workers' low overall skill levels and learning rates (Stratman *et al.* 2004, Finegold *et al.* 2005).
- *Scheduling.* The scheduling of training of a large volume of people with a high turnover involves tremendous coordination efforts. New hires have to receive training within a short time period before they can start the job.
- *Training packages.* Temporary workers generally have less training and lower skill levels and usually come with a lack of depth and experience in routine continuous process improvements upon entry into the organisation (Caudron 1994, Lapre *et al.* 2000, Ittner *et al.* 2001). Thus, a variety of training packages catering for various skill bases are required. However, should training be focused for the short or the longer term?
- *Training costs/length of training period.* The costs of training and how much training to give the temporary workers could be an issue. How long should the training period be? What impact does this have on the learning rate of the employee and hence the quality of the recruit/employee may be important (this could be related to the learning rate/length of training and getting up to the required performance targets). New hires are likely to be unfamiliar with the business processes and therefore are going to take longer to get up to the required performance standards and the learning rate of temporary workers is likely to be lower than that of permanent recruits.

Given the above challenges the big question is, how can firms manage lean training for flexible workforces?

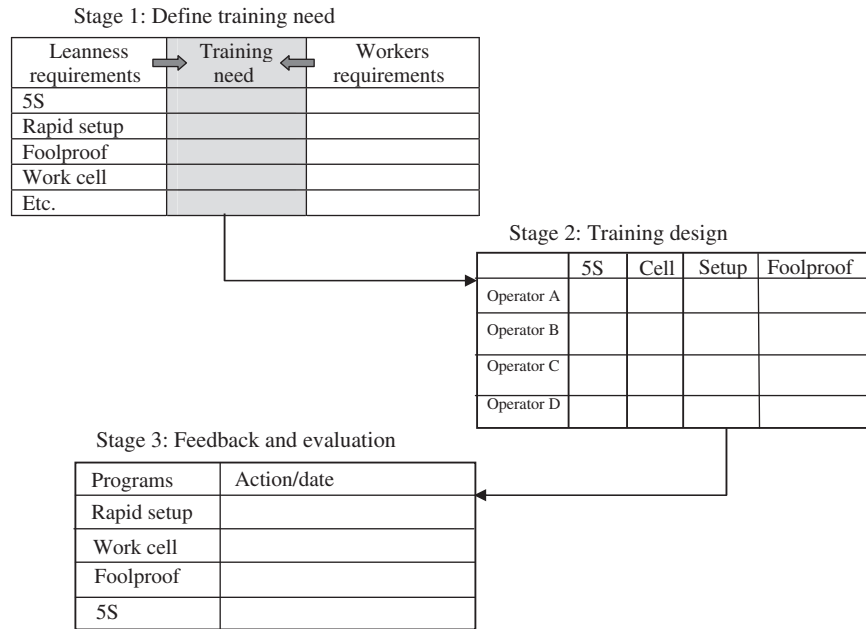


Figure 2. The LQOT framework.

Like all companies, Toyota has to deal with peaks and troughs in the marketplace. They employ considerable numbers of temporary workers (from contract companies) to smooth the demand for labour to enable production requirements to be met both efficiently and effectively. This can be 20% or more of the workforce (Liker 2004). Thus, how does Toyota manage training for flexible workforces? Toyota does not show the same level of commitment to temporary workers as they do to their permanent staff. But they do have long-term relationships with the contract labour companies who understand Toyota's requirements and Toyota provide these outside firms a steady business environment (Liker 2004). In other words, the outside firms are responsible to provide Toyota with workforces equipped with lean knowledge and skills.

#### 4. A lean quality of training framework

Implementing lean manufacturing requires significant training for everyone in the organisation (Womack *et al.* 1990, Mann 2005). Thus, an effective training plan for flexible workforces is vital to firms' lean operations strategy. Due to the various skill bases of the temporary workers, it is helpful to have an organised approach for setting the right training needs and packages. This article proposes a Lean Quality of Training (LQOT) framework which can assist firms in addressing the challenges discussed above. Moreover, the framework

will help managers to consider the ease or difficulty of administration and scheduling given available resources. The framework is derived from existing training literature and draws on research and practical experience of the authors. The LQOT framework (Figure 2) consists of three main stages:

- define the training need;
- training design;
- feedback and evaluation.

##### 4.1. Stage 1: define training need

In this stage, training needs for the temporary workers would be determined. In the literature, there are two theoretical approaches to Training Needs Analysis (TNA) namely: (1) the organisation–task–person (O–T–P) analysis framework and (2) the performance analysis approach. The former has dominated the academic literature, whilst the latter has been more popular among practitioners (Taylor *et al.* 1998). Nonetheless, the identification of a training need does not necessarily depend on there being gaps between expected and actual levels of results as emphasised by the above two theoretical TNA approaches. This is especially true for lean (i.e. continuous improvement) in a manufacturing setting. For example, training efforts might be continuously applied towards minimising waste, improving quality and reducing lead times. What is more appropriate in

identifying training needs will be to focus on long-term lean requirements even in the absence of any expectations.

To define the training need, managers should have a clear understanding of the level of 'leanness' to be implemented before the training requirement for temporary workers could be established. Thus, the steps involved would be:

- Identify the elements of lean manufacturing that are applicable and prioritise them. Lean is a company-wide involvement; the idea is not for managers to pick and choose what lean techniques are to be implemented. Rather, this step requires managers to identify what aspects of the tasks that temporary workers are likely to deal with and the lean techniques that are associated with the tasks. For example, 5S is a basic lean element and all workers should be trained on this. However, heijunka or load levelling may not be required for temporaries who only assist in materials handling or cleaning. The degree of lean adoption is varied from firm to firm, thus this assessment helps managers identify the needs of the firm and avoids wasting resources and time in training.
- A task analysis seeks to specify the main duties and skill level required. This step helps ensure that the training which is to be developed will include relevant links to the content of the job. To ensure consistencies, managers should work with the human resource officers who may already have conducted the task analysis during the recruitment process.
- To analyse users level of existing knowledge on the subject and their learning style, several basic assessment techniques such as direct observation, questionnaires, interviews and tests could be adopted.
- Categorise the workers into logical groups with similar training needs.

#### 4.2. Stage 2: training design

In this stage, analysis would be carried out to address the questions posed about what should be the depth of knowledge or content of the training. What are the required core and peripheral skills? The idea of separating core versus peripheral skills is important to ensure that workers have the right set of capabilities to carry out the assigned tasks. Core skills can be defined as the set of capabilities that are specific to a firm or industry. Whereas peripheral skills are the basic

or industry-wide skills that workers should possess. For example, for the tooling industry, ability to programme CNC machines and tools change are core skills, whereas maintaining machine cleanliness could be considered as a peripheral skill (although this skill is vital for lean implementation).

Once the skill sets have been identified, the idea is to reduce the amount of peripheral skill requirements as much as possible. This means, the recruited temporary workers should have the common/basic industry specific skill set. What is left for managers would be to train them in the core skills sets that are specific to the company and industry. In doing so, managers could focus the design of the training programme on specific skill sets. Training workers on periphery skills could be minimised and thus reduce costs and time required for workers to get on the key tasks right away.

With that, managers could then identify and set various programs (on-the-job training, for example) and time requirements. The National Vocational Qualification (NVQ) (Directgov 2011) guidelines could be used as a baseline to design the training program. The various competence-based qualifications under NVQs could serve as a basis for developing temporary workers' skills and knowledge to do a job effectively. Then, managers could see how existing (or new recruit) qualifications held by the workers compare and how one type can lead on to another. Moreover, the National Qualifications Framework sets out the level at which a qualification can be recognised in the UK, thus providing additional stimulus for temporary workers to take the training seriously.

Finally, a matrix could be used to show the workers tasks and their required training programs. This step also allows managers to estimate the costs involved in training the temporary workers. The aim is not to end up as a training ground for temporary workers. If needed, the training could be outsourced to a manpower company that would provide their own trainers and could take responsibility of the training for the temporary workers.

#### 4.3. Stage 3: feedback and evaluation

Stage 3 is about feedback and evaluation of the developed training program. A LQOT diagram (Figure 3) could be constructed to monitor the training performance. Moreover, the LQOT diagram could provide a visual guidance for evaluation. The diagram should be managed by the training manager and monitored on a daily basis:

- Leanness requirement – this diagram highlights the results from Stage 1 analysis.

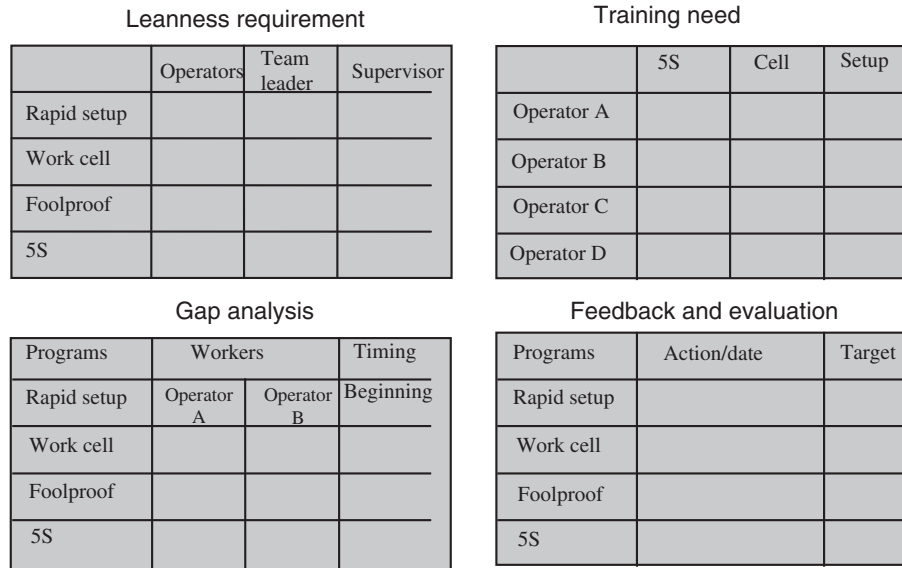


Figure 3. LQOT diagram.

It shows the leanness requirements in both operations and workers, i.e. which lean techniques and the amount of knowledge needed at each level of worker.

- Training need – this diagram shows the workers' training needs, based on the company leanness requirements. It shows the amount of training need for each worker corresponding to various lean techniques.
- Gap analysis – this diagram shows the skill and knowledge gap for each worker. It highlights the status of training provided to each worker. For example, Operators A and B are in the 'beginning' training phase of the rapid setup technique (SMED).
- Feedback and evaluation – this diagram shows feedback and suggestions from the workers. It shows how effective the training has been carried out and what actions could be taken to improve future training initiatives and programs.

## 5. Case study

To test the applicability of the proposed framework, a case study was conducted at Company A, one of the largest cookware manufacturers in the UK. To stay competitive, Company A had recently embarked on the implementation of lean. The company employed contractual workers in manufacturing operations hired from the community at large. Although few positions,

including engineers and supervisory staff, are permanent, more than 20% of jobs in the press shop are required on an 'as needed' basis to conform to the job orders at any given time. Successful lean implementation required workers commitment and participation. How to train these temporary workers, who have a high turnover with a variety of skill levels, is a significant problem that needs to be addressed. Many of the workers are of Eastern European origin and some of them have a low comprehension of English. When approached by the researcher, the Improvement Engineer in Company A was keen to collaborate to see how the Lean LQOT framework could assist in improving the management of temporary workers.

The proposed LQOT framework was used to identify the training needs of the fabrication department, which has 20 temporary workers and 6 permanent workers in roles such as production supervisor, mould designer, setter, engineer and two operators (aka team leaders). The participants were the Operations Manager, the Engineering Manager, an HR officer and the Improvement Manager (who also acted as the project champion). In total, three half-day workshops were needed to apply the process and framework. The researchers acted as facilitators throughout the process. Data such as completed forms and managers feedback were collected at the end of each workshop.

The process started with a briefing of the LQOT framework and its associated process. The degree of 'leanness' requirements were established using the company's 2-year lean plan. As most of the temporary



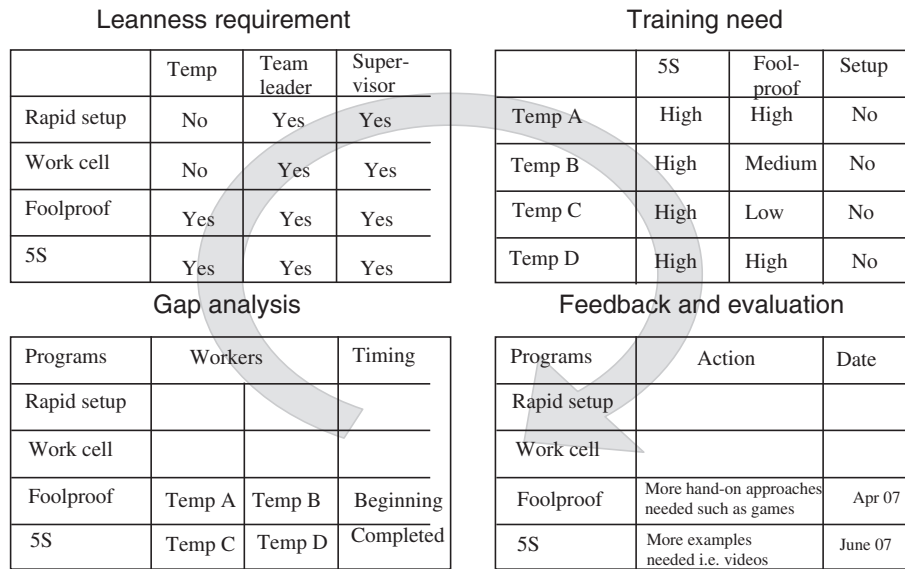


Figure 4. LQOT diagram – Training Monitor Example.

workers tasks were to assist operators in operating machines, their duties were machine cleaning and feeding in boxes which required few skills or knowledge. However, their involvement in 5S or other lean activities were important to keep the overall lean programme in place. The level of skills of temporary workers was collected through the agents who managed the workers. The gap analysis identified that the majority of the temporary workers had little or no knowledge of lean management at all. Figure 4 illustrates the training needs that resulted from the analysis. 5S and foolproof techniques were decided as the foundation level that the temporary workers and other permanent workers should at least be familiar with. Setup reduction and cellular manufacturing would be the next level but only for the supervisors and team leaders. The Improvement Engineer checked the NVQ in the Lean Manufacturing programme and was happy to learn that the training analysis and training needs were aligned closely with NVQ levels.

In terms of separating core and peripheral skill requirements, the team found that the process was quite straightforward as most temporary workers were mainly employed for peripheral tasks. Nonetheless, the team pointed out that this stage is very useful as it triggered them to think of other options. For example, it may be worthwhile to engage an outside trainer to do the training or to find an agency that could provide the workers with the required skill sets.

In order to speed up the training process and enhancement of learning, three types of training formats – workshops, on-the-job training and use of

videotapes and games were adopted. This depended on the nature of the tasks to be performed and the number of people to be trained. For rapid deployment in future training, standardisation of training materials was initiated. It removed the guess work involving in putting a package together for the trainers and standardisation has provided them a predictable format. The team pointed out that training design was not the most difficult task. The main challenge was finding competent staff to do the training which was not a small matter, especially since the staff had to learn what they themselves would be teaching within a matter of days. Progress of the training was monitored and recorded on the LQOT diagram (Figure 4). The diagram showed that temporary workers required training for the 5S and foolproof (poka-yoke) techniques. Knowledge on setup reduction (SMED) and cellular layout was deemed not to be required as the temporary workers will not be assisting in any setup nor cell design. Weekly meetings were conducted to review and improve the training packages.

At the end of the case study, a meeting was held to elicit feedback from participants to assess the effectiveness of the LQOT framework and process. The feedback was built using the key process assessment criteria proposed by Platts (1993). This consisted of the following criteria: (1) feasibility – to assess if the managers could follow the process; (2) usability – to assess if the process was easy to follow, if not, what difficulties were encountered and what did they result from and (3) utility – to assess if the process produced a ‘good’ output and was worth following.

Overall, the feedback from Company A was very positive. The LQOT framework was easy to use and understand. Prior to this, the company approached training for temporary workers on an *ad hoc* basis. One of the team members suspected that the company may have been used by many casual temporaries as a 'free' training ground. The LQOT approach provided a structured approach for the company to identify, design and monitor the training needs. Moreover, it helps to reduce 'waste' in terms of providing unnecessary training on skills (techniques) that are not required by the temporary workers. Moreover, focused training enables temporary workers to get on the job more effectively. One of the managers pointed out that some of the workers did not like training, and by providing only the required training, at the right amount and at the right time helped to win over their cooperation both in the job and in contributions to continuous improvement initiatives.

The team also stated that the LQOT diagram provides a powerful visual monitor of the training performance. It shows if the training was progressing as planned and enabled them to take remedy actions without wasting further time and resources. The Improvement Engineer was taking NVQ in Business Improvement Techniques when the case was conducted. Although not strictly comparing apples with apples, he commented that the proposed LQOT was more structured and could be used to identify training specifics to Company A's needs. For example, in this case, a structured process to manage the training need for temporary workers would be applicable. This is different to the widely recognised NVQ which provides a blanket approach to education and training. As Company A does not have any lean training program in place, the team decided to immediately adopt the LQOT framework.

### 5.1. Postscript

In the months after the case, there was further restructuring in the company. The Improvement Engineer said that the recommendations from the framework were suitably sufficient to manage the temporary workers' training requirements. However, with the new management team in place a lot of uncertainties exist. Especially, if the management team decide to outsource fabrication operations to lower cost countries, then there will be no training needs of temporary workers to worry of at the organisation itself.

## 6. Discussion and conclusion

Globalisation has brought increased competition with labour markets becoming more flexible to enable organisations to compete on a global scale. There are more part-time workers, temporary employees and contractors in the employment mix of the average large corporation than there used to be. Changes in labour input can have significant consequences on performance because of potential misalignments with existing structural, infrastructure and integration factors. Thus, for firms to enhance the efficiency and effectiveness of lean adoption, an effective framework is required to assist them in managing the training needs of temporary workers.

Therefore, the new challenge is how to get more from contractual temporary workers than just making up the numbers in a very short-term timescale. How can organisations effectively train and invest in temporary workers to improve the performance through lean initiatives? A case study with Company A indicated that the proposed LQOT framework was effective and applicable. Although the underlying ideas of a training skill matrix and gap analysis are not new, their combination within a structured procedure provides a practical, usable and useful process for managing flexible workforce development.

The approach to manage and train temporary workers is frequently carried out in an *ad hoc* manner based on managers' experience. A formal framework and process provides a mechanism for combating this tendency. This research shows that managers liked the formality of the process. A formal process helped managers to decompose the complexity of managing temporary workers' training needs into manageable steps. The case study indicated that decisions made with the assistance of the LQOT framework would have a higher level of confidence attributed to them.

The value of visualisation (provided by the LQOT diagram) in the process was also demonstrated. The feedback from Company A showed agreement that the LQOT visualisation gives more information about the state of the temporary workers' training needs than a usual training matrix and that helped managers to reduce inconsistencies in a training provision. The inclusion of a visual cue for the required performance (for each temporary worker) and facility to inspect prior training status (all in a single diagram) were both identified as elements that would have closed this gap in accuracy and ease of interpretation. Managers in Company A agreed that the LQOT framework showed where training was required (to improve sequence performance) and that it was easier to anticipate deviations from the schedule. Overall, it was agreed

that the framework gave a more intuitive picture of the training requirement.

Application of the framework and process has provided a number of insights into aspects of flexible workforce training need analysis, which add to academic understanding and could form the basis of further work. The findings of this research contribute to existing bodies of knowledge in terms of (a) complementing the core-periphery model, i.e. providing a framework to assist firms to manage training needs of temporary workers in achieving flexible firm requirements; (b) providing a structured approach to assist firms in identifying lean training needs for temporary workers. Much of the existing training frameworks are focusing on permanent workers – this research fills the gaps in existing lean training literature and (c) adding to existing training of temporary workers' literature by illustrating how some of these issues could be overcome as well as highlighting the challenges when approaching the set-up of lean training programmes.

The initial findings of the framework are very encouraging. There is a clear need to undertake further research and develop the framework with other organisations and pose the questions: (a) Could the framework be applied in industries (i.e. electronic) where there is a large volume of temporary workers who are hired to work on core tasks? Thus, an area ripe for future research is an examination of the general ability and wider application of the proposed framework; (b) How can contractual/temporary workers contribute to the success of lean operations and continuous improvement initiatives through better training? (planning, design and implementation) and (c) How can organisations approach the challenge of how to maximise the benefits of numerical flexibility and to develop functional flexibility in contractual workers in order to fully utilise them for lean initiatives?

#### Notes on contributors



**Kim Hua Tan** is an Associate Professor in Operations Management at Nottingham University Business School. Prior to this, he was a researcher and a teacher at Centre for Strategy and Performance, University of Cambridge. Dr Tan spent many years in industry before joining academia in 1999. His current

research interests are operations strategy, lean management, supply chain risk management and performance measurement. Dr Tan has published numerous articles in academic journals such as *Decision Sciences*, *International Journal of Production Economics*, *International Journal of Production Research*, and others.



**Paul D. Denton** graduated in 1994 with a BSc (Hons) degree in Computing from Liverpool University and attained an MSc in CIM and a PhD in Manufacturing Business Systems from Loughborough University in 1995 and 2003, respectively. He has held a number of senior management roles within worldwide manufacturing and logistics enterprises and is a chartered member of the Institution of Engineering and Technology. Paul is now a Project Manager within the School of Computing and Engineering at The University of Huddersfield, pursuing research in the fields of Manufacturing Management and Enterprise Engineering.



**Rosalind Rae** is a Lecturer in Business and Management (Operations Management) at Aberdeen Business School, The Robert Gordon University. She held positions in GlaxoSmithKline, Mars and PepsiCo over a 10-year period in varying roles from Manufacturing Operations; R&D (New Product Development); Process Improvement; Quality and Vendor Assurance; Distribution; Technical Projects. Her research interest is flexible labour, the interface between Human Resource Management and Operations Management and the impact of HR policies on Operational Performance.



**Leanne Chung** is a Lecturer in Human Resource Management and Organisational Behaviour. She holds a PhD in International Business and Management from Judge Business School, University of Cambridge. Her research interest is knowledge management, China business and human resource management.

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