ARTICLE

Cellular and organisational team formations for effective Lean transformations

Herbert De Vries and H. M. Van der Poll

Graduate School of Business Leadership, University of South Africa, Pretoria, South Africa

ABSTRACT

Teamwork is considered essential for effective Lean organisations. However, how and why are teams formed during a successful Lean transformation relative to changes in organisational structure? Constructs for variables and factors that influence formation of teams, during and after Lean transformation maturity, were identified. The research employed a purposively sampled case study with three questionnaires, focus groups, interviews and multiple linear regression. Self-directed teams become flow-line or cellular-work teams, supported by dedicated cross-functional teams led by first line managers who run manufacturing cells as small business units. Participation of cellular team members leads to ongoing commitment and continuous improvement within the team leading to restructuring of organisations for effective flow and pull. Cross-functional team activity and self-directed team activities are vital components for successful Lean transformations. Constructive, humble, and common-sense leadership is required for team formations. Future research could investigate literacy coupled with Lean transformations for South African organisations.

Abbreviations: TPS: Toyota production system; JSE: Johannesburg stock exchange; SMED: single minute exchange of die; TW: Teamwork; PARTINV: Participation and Involvement; CELFM: Cellular Format – self-directed team activity; LHINT: Level of Horizontal Integration – cross-functional team activity; LOCDM: Locus of Decision-Making – by organisational level; TAG: Taguchi; CTR: Cycle Time Reduction; 5S: Five-S; TPM: Total Productive Maintenance; KAN: Kanban pull; VIS: Visibility; KAIZ: Kaizen; HOSHK: Hoshin Kanri; 7W: Seven wastes; PROB: Problem solving; STAND: Standard work; SPF: One Piece Flow; CM: Cellular Manufacturing; HEU: Heijunka; DISTVAL: Value per customer; VSM: Value Stream Mapping; POKJID: Mistake proofing; SMED: One digit exchange of die; POLDEP: Policy Deployment

1. Introduction

In 2015, after previous recalls of the Corolla and Camry in 2010, Toyota, the originators of Lean theory and practice, again recalled some of its vehicles (Eye Witness News, 2015; MacKenzie, 2010). Pertinent questions arose: What is happening to this
organisation that delivered the Toyota production system (TPS)? What is going wrong? The answer may lie in the comment, ‘Toy"a has gotten smug. It believes the Toyota Way is the only way’ Fortune 500, (2010). It would appear that the Shusa, the Japanese word denoting the top person leading the team responsible for a motor vehicle from design to manufacturing, has lost his way Fortune 500 (2010).

As emphasised by the father of the TPS, Ōhno (1988), teamwork is considered essential for effective Lean organisations. Brown, Collins, and McCombs (2006) observed that Lean transformations are often hindered by structures that are based on departmentalisation and that human processes create intangible barriers that block the communications so vital for Lean to take root. According to Mostafa, Dumrak, and Soltan (2013) the human element is an inherent characteristic in a Lean manufacturing system. They further argue that the Lean implementation process can be restricted based on negativity and misunderstanding of the Lean concept and it can decrease the expected organisational benefits. However, how and why teams form and evolve with Lean transformations, relative to changes in organisational structure, is investigated in this article.

Haug (2008), who regards organisational restructuring as a key feature of Lean organisational restructuring, stresses that it is a double-edged sword for organisations that wish to compete globally, realising that unless a Lean process is achieved, there will be little progress in desired growth. Considering team based organisational transformations, Grütter (2004) identified a low success rate for this type of organisational transformation for South African organisations. Furthermore, only a few organisations in South Africa have succeeded with Lean implementation according to Vermaak (2008); de Vries and van der Poll (2016); Coetzee, van der Merwe, and van Dyk (2016).

Careful analysis of the literature directly related to organisational change involving teamwork and organisational restructuring (Nahm, Vonderembse, & Koufteros, 2003; O’Carroll, 2004; Haug, 2008) did not reveal how and why teamwork played such a significant role in the Lean transformational process. Various authors (Angelis, Conti, Cooper, & Gill, 2011; Cameron-Strother, 2009; Gagnon, 2004; Harris, 2007; Pinheiro, 2010) linked Lean thinking to organisational behaviour. However, they did not provide insight regarding how and why effective behaviours emerge from the team processes that may invariably be required to assist with and sustain the transformation process. Limited research could be found that linked Lean disciplines and techniques directly to team formations, team processes and team behavioural disciplines.

Womack and Jones (2010) provide many examples of teams in different organisations; however, the details of how and why these teams achieved success in operations, apart from the technical motivations, appear to be lacking. In South Africa, Grütter (2004) conducted valuable research on team-based work organisations, however, his work was specific to shop-floor teams and their achievements and did not cover the role of teamwork in the context of a total Lean transformation. Mostafa et al. (2013) established that by building a Lean expert team success in Lean implementation is improved. According to van der Merwe, Pieterson, and Lourens (2014) this is achieved through the creation of a vision, training, successes, teamwork, structure and performance.

This article studied two cases involving discrete manufacturing organisational restructuring and organisational behavioural change in the context of teamwork in South Africa. One of these was in the process of Lean transformation, and the other had concluded a successful Lean transformation. The research linked teamwork, organisational restructuring and
behaviour directly to Lean techniques implementation and provided new guidelines for team structures that lead to effective Lean organisations.

The outline of the article is as follows: A literature review is done on organisational structure, teamwork, and Lean thinking. This is followed by the research concept portraying the research questions, the research methodology, together with the hypotheses. The findings and outcome are discussed after the research design. This is divided into a discussion based on the quantitative and qualitative analysis. In the qualitative analysis case studies F01 and W01 are discussed followed by a qualitative analysis of the replicated patterns identified for cases F01 and W01 discussed per proposition. The article concludes with a summary and an indication of future work.

2. Literature review

From the Japanese organisation Toyota’s turnaround (Ôhno, 1988) in the 1970s and the subsequent study of the TPS by Womack and Jones (2007), followed by a clarification of theory in 1996 by Womack and Jones (2010), Western organisations have attempted to emulate Toyota. However, the success of Lean implementations remains in contention (Coetzee et al., 2016; Cooper, 2011; van der Merwe et al., 2014).

The following approaches for Lean success were previously researched: implementation frameworks (Mostafa et al., 2013; Quarterman, 2007); Lean thinking for maintenance processes (Mostafa, Lee, Dumrak, Chileshe, & Soltan, 2015); Lean applications such as Heijunka (Jones, 2006); value stream mapping (Rother & Shook, 2003); organisational behavioural issues (Losonci, Demeter, & Jenei, 2011; Sawhney & Chason, 2005); management and leadership issues (Johnson, 2009); and organisational culture (Gander, 2009; van der Merwe et al., 2014). In the following sub-sections, Lean and the organisational structure; teamwork and Lean thinking; and organisational behaviour and Lean thinking are discussed.

2.1. Lean and organisational structure

Linking Lean thinking with organisational structure, Nahm et al. (2003) identified five constructs for the organisational structure: the number of hierarchical layers, levels of horizontal integration, the locus of decision-making, nature of formalisation and the level of communication. The level of horizontal integration was considered in the quantitative analysis as a measure of cross-functional team activity and the locus of decision-making as a measure of team activity by organisational level. Taking into account the analysis of the work by Haug (2008) and considering that Lean organisational structures should be developed along the value stream of the organisation, cellular format can be added to the constructs.

Prevalent functional organisational structures mostly impede the Lean process, as indicated by O’Carroll (2004); Haug (2008); Hettler (2008); Cooper (2011); and de Vries & van der Poll (2016). According to the authors, limited literature seems to be available regarding a solution to this dilemma. However, according to Haug (2008) restructuring along the value stream appears to be the best option. This observation by Haug (2008) is of major significance to this research as it clearly indicates in two case studies, the concept of manufacturing cells reporting formally, in line to senior management.
2.2. **Teamwork and Lean thinking**

Rother (2011) defines a Lean team as ‘[a] group of people equipped with PDCA skills and Lean-specific knowledge, who learn in a directed, meaningful way.’ Hence, Oropesa Vento, García Alcaraz, Maldonado Macías, and Martínez Loya (2016) with regard to Kaizen applications and work teams, argued that workers must be trained to perform different tasks of several positions and that managers need to be trained in teamwork and problem-solving techniques, being able to form teams to work at solving organisational problems. Furthermore, Myerson (2013) identified two keys for success in any team-based activity, namely: support from upper management and the participation of everyone in the organisation. He further states that to build successful teams executive leaders must communicate that they expect teamwork and collaboration; organisation members should talk about and identify the value of a teamwork culture; management should encourage employees to emphasise teamwork, and the organisation should reward and recognise teamwork.

Myerson (2013) is supported by Caliskan (2016), who researched Lean teamwork in Albania and found management commitment; focus on training; project selection; strategy for implementation and the focus on the results as factors for success with Lean teamwork. Furthermore, according to Angelis et al. (2011) task support positively influences commitment. They argue that to perform tasks and for production and quality standards to be met, co-employees, team members and managers should provide task support. Management support, fairness, and competence are physically evidenced by the availability of the task support and commitment from the team members. Furthermore, Johnson (2009) encourages constructive Lean leadership.

Constructive leadership may lead to empowerment of employees, subsequently Myerson (2013) encourages employee empowerment since employees provide knowledge and are involved in daily operations. By following a problem-solving process, managers can show respect for employees’ knowledge and the commitment to find the best solution (Coetzee et al., 2016). Furthermore, Jumara (2005) and Kent (2006) established that well-developed, self-directed work teams developed remarkable skills that replaced many organisational functions. Of major significance to this research is the work by Jumara (2005) which points to a unique organisational structure consisting only of self-directed teams.

2.3. **Organisational behaviour and Lean thinking**

Some specific organisational behaviours with the Lean process that feature prominently are point to open, free-flowing communication, empowerment and affective commitment (Boyle Scherrer-Rathje & Stuart, 2011; Cameron-Strother, 2009; Gagnon, 2004; Harris, 2007; Poppendieck, 2002).

In contrast, Cooper (2011) identified the following as key to successful Lean implementation: highly capable leadership; communication channels with effective feedback; the development of collaborative relationships between management and employees; being well versed in the practice of change management; and understanding how to effect change in culture. Furthermore, organisational culture was considered an aspect by Gander (2009) and Angelis et al. (2011) indicated that the organisational culture will change with Lean.

How employees react to change may be directly associated with cognitive attitudes. Tress and Espinoza (2012) identified 36 cognitive attitudes positively associated with Lean
implementation and for the quantitative analysis of participation of employees in the Lean process, these were considered a measure of positive attitudes. Wickramasinghe and Wickramasinghe (2011) argue that an employee’s sentimental commitment characterises the attachment that an employee has to the organisation. Therefore, they hint that an employee who is attached emotionally to his or her work will continue to work for the organisation. This may be an indication that if organisational behaviour could lead to committed employees, it may be essential for the successful implementation of Lean.

3. The research problem

Management and employees need to work in teams to overcome the fear of change when an organisation embarks on Lean transformation. Cooper (2011) provides examples of reasons for failure: the dismissive relationships between production and industrial engineering employees, and the senior manufacturing engineer undermining the director of operations and the lack of top management support. Hence, the influencing factors and variables identified from the literature review in Figure 1 illustrate the research concept.

Figure 1 shows that Lean principles and techniques have an influence on corporate strategy; the organisational transformation; the organisational structure and team formations. Leadership and corporate culture are considered as influencing factors.

3.1. Research questions

The main research question was how and why teamwork plays such an important role during and after Lean transformations have reached a stage of maturity.

The sub-questions were:

- How do management and employees deal with having to operate in teams to a greater extent than previously?
- Why do management and employees become willing to work in teams?
- How do teams form during Lean transformations?
- Why do teams form during Lean transformations?
- How do particular team forms work for the organisation?
- Why do particular forms of teamwork work for the organisation?

3.2. Research methodology

A purposively sampled, sequential mixed method case study methodology was utilised. The case study method was chosen since Meredith (1998) argues that it helps the researcher to understand the principles underpinning events and mechanisms that can be identified by quantitative means. The methodologies utilised by Grütter, Field, and Faull (2002), Lander (2007), Kucner (2008) and Haug (2012) were based on a case study methodology approach.

Two discrete manufacturing organisations were selected from 18 possible identified organisations who were involved with Lean thinking. After numerous approaches in the form of e-mails to these organisations’ chief executive officers and/or Lean representatives,
only two responses revealed two discrete manufacturing organisations pursuing a Lean transformational strategy. These two declared themselves willing to participate in the research.

The first case study was conducted and an individual report was written moving to the second case study. From the two case studies, individuals from senior, middle and operational management as well as non-management literate employees were interviewed. Interviewees participated in both the qualitative and quantitative research. In utilising the mixed method methodology, a quantitative analysis was done along with the case study qualitative approach, as proposed by King, Keohane, and Verba (1994).

Three Likert-scale questionnaires with closed-ended questions were used to obtain the quantitative data from the participants. The 5-point Likert-scale for the first questionnaire was as follows:

- not observed at all;
- process has commenced;
- action plan/program to establish;
- action plan/program implemented; and
- processes and procedures are fully entrenched.

![Figure 1. Research concept.](image)

*Source: Authors' own synthesis of the research concept*
The first questionnaire was a lawn audit to determine the extent of Lean achieved by each of the organisations.

For the second and third questionnaire, a 5-point Likert-scale was used, namely:

- strongly disagree,
- disagree,
- neither agree nor disagree,
- agree and
- strongly agree.

The second was used to identify the changes in organisational structure due to Lean transformation and the third to identify the behavioural changes that were taking place due to the Lean process.

The interrelationships of Lean techniques as the independent variable influencing teamwork, organisational structure, and behaviour as the dependent variables were observed, and multiple linear regression analysis was utilised to determine the pertinent interrelationships. Structured questions based on the same variables were used for the qualitative research. Pattern matching methodology as in Yin (2014) was utilised to evaluate the propositions developed for the research. The quantitative data is relevant only to the two selected cases and although not regarded as generalizable, it was regarded as invaluable to derive the case study constructs and propositions for the qualitative research. Twenty Lean techniques have been identified from the literature based on definitions provided by Quarterman (2007) and Womack and Jones (2010). With the exception of teamwork, these techniques were utilised as the independent variables for the research (refer Table 1).

Applying the variables to an application model for Lean techniques implementation, the flow diagram shown in Figure 2 was used to generate the hypotheses.

Based on the model in Figure 2 the following hypotheses were developed:

The main hypothesis: The implementation of Lean thinking will transform the organisation from a formal functional structure to a structure with team formations conducive to the Lean process.

The null hypothesis: The implementation of Lean thinking will not result in more teamwork formations.

From these, the following sub-hypotheses were formulated:

**H1** The more progress is made with the Lean process, the more teamwork will occur.

**H2** The more progress is made with the Lean process, the more horizontal integration and cross-functional teamwork will occur.

**H3** The more progress is made with the Lean process, the lower will be the locus of decision-making, indicating more effective self-directed team activity at lower organisational levels.

**H4** The more progress is made with the Lean process, the more participation and involvement of employees will occur, resulting in more teamwork.
The more progress is made with Lean flow techniques; the more cellular manufacturing will develop, leading to more self-directed teamwork in cells.

Regression analysis yielded the R, R^2 and the F statistic. The b coefficients of the independent variables provided the nature of the relationships.

Two sets of questions were designed for the case study: a set of open-ended questions for individual interviews; and a set of open-ended questions for the focus groups. Deriving the questions for the interview of individuals was achieved through matching

**Table 1. Constructs and Lean techniques coded as dependent and independent variables.**

| Constructs utilised as the dependent variables for teamwork activity | Organisational teamwork variable | Abbreviation and code | Organisational teamwork variable | Abbreviation and code |
|---|---|---|---|---|
| Teamwork | TW | Level of horizontal integration – cross-functional team activity | LHINT |
| Participation and involvement | PARTICINV | Locus of decision-making – by organisational level | LOCJM |
| Cellular format – self-directed team activity | CELFM |

**Lean techniques utilised as constructs for the independent variables**

| Construct | Abbreviation | Code |
|---|---|---|
| Taguchi | TAG | Cycle time reduction |
| Five-S | 5S | Total productive maintenance |
| Kanban pull | KAN | Visibility |
| Kaizen | KAIZ | Hoshin Kanri |
| Seven wastes | 7W | Problem solving |
| Standard work | STAND | One piece flow |
| Cellular manufacturing | CM | Heijunka |
| Value per customer | DISTVAL | Value stream mapping |
| Mistake proofing | POKJID | One digit exchange of die |
| Policy deployment | POLDEP |

**Source:** Authors’ own synthesis of dependent and independent variables

**Figure 2.** Model for Lean techniques as independent variables influencing organisational variables.

**Source:** Authors’ depiction of dependent and independent variables

**H5** The more progress is made with Lean flow techniques; the more cellular manufacturing will develop, leading to more self-directed teamwork in cells.
propositions to specific questions. Propositions were never mentioned during the individual and group interviews in order to eliminate bias from the respondents. The focus group questions were based on the assumption that organisations adopting Lean transformation would be working towards total employee involvement and teamwork and that Lean thinking is perceived as a total transformational strategy for an organisation.

A process such as Hoshin Kanri, with policy deployment, was an essential part of the formulation of a Lean transformational strategy and these techniques were taken into account when selecting the particular exploratory cases. With the selection process completed, focus groups were considered to include: the top executive group; a cross-functional group chosen by the organisation to implement the Lean strategy; or an active self-directing team, working within a manufacturing cell, meeting customer requirements using the Lean principles of flow and pull and the Lean techniques. The top management groups in both organisations expressed their willingness to participate in the focus groups.

Based on the quantitative analyses, the developed models and the research questions, the research propositions listed in Table 2 were developed for the research based on the techniques for case studies as per Yin (2014).

The research propositions in Table 2 were used with the qualitative analysis. Yin’s (2014: 45) validity testing methodology was utilised for the qualitative results. Construct validity was achieved through the use of multiple sources of evidence. Through pattern

| Research question | Proposition – M signifies main, and S signifies sub |
|-------------------|---------------------------------------------------|
| How does teamwork play such an important role in Lean transformations? | MP1 From initial resistance to Lean implementation, team formations will counter functional and management impediments caused by formal functional structures. Teams will form in line with specific Lean technique resource allocation requirements. |
| Why does teamwork play such an important role in Lean transformations? | MP2 Teamwork will make the process of Lean implementation less complex with more cross-functional interactions utilising Kaizen. Commitment and attitudes will change within teams due to the understanding that emerges with the increasing application of Lean techniques. |
| How do management and employees deal with having to operate more in teams? | SP1 From initial resistance, team activities will lead to growth and benefits for team members. Organisational learning will be more effective and employees will experience more empowerment. |
| Why do management and employees become willing to work in teams? | SP2 Participation in teams will provide learning opportunities for employees to contribute and be recognised for their ideas and contributions. |
| How do teams form during Lean transformations? | SP3 Departmental and functional teams will work at basic and more advanced flow techniques to assist work teams who will implement and maintain techniques. |
| Why do teams form during Lean transformations? | SP4 Total involvement of all employees will be facilitated through team formations in line with the particular Lean techniques resource allocation requirements. |
| How do particular team forms work for the organisation in terms of specific Lean techniques? | SP5 Team formations will emanate from the need to develop continuous flow utilising the best applicable techniques, from the less to the most complex flow techniques. |
| Why do particular forms of teamwork work for the organisation? | SP6 Team formations will consist of cross-functionally integrated teams supporting flow-line teams. A new team culture will emerge with a high-performing, benefit-sharing organisation. |

Source: Authors’ own developed propositions
matching internal validity was achieved whereas external validity was attained as logic was replicated to the second case study. A case study protocol was applied for reliability.

3.3. Case study validity

Construct validity was achieved when the hypotheses supported the propositions; multiple sources for information were utilised with questionnaires’ data analysis, value stream mapping, organograms and Lean storyboards; and top teams acted as key informants with group sessions. Internal validity was attained through the analysis in Section 4 and the explanations provided. Replication was established for both cases as outlined in the detailed findings as in Section 4, which in turn rendered external validity. Reliability of the study was achieved through a case study protocol that was consistent in terms of the approach followed, dealing consistently with each participant.

4. Outcome and findings

The outcome and findings of the research are discussed in the following sections dealing firstly with the quantitative multiple regression analyses followed by the qualitative case study analysis.

4.1. Quantitative analysis

The multiple regression results are summarised by hypothesis as follows:

**H1:** The more progress is made with the Lean process, the more teamwork will occur.

Was highly significant with positive coefficients for 17 of the 19 Lean techniques, with a regression equation of:

\[
TW = 0.017 + 0.089HOSK + 0.074POLDEP - 0.045DISTVAL + 0.0197W + 0.055PROB + 0.011KAIZ + 0.0595S - 0.007TAG + 0.045CTR + 0.110SMED + 0.021VSM + 0.063CM + 0.039SPF + 0.039POKJID + 0.000KAN + 0.008HEIJ + 0.045VIS + 0.049TPM + 0.310STAND
\]

**Supported by:** R squared = 0.90, standard error = 0.4316, f statistic = 22.75, Durbin-Watson Statistic = 1.79, critical F = 1.641 at a 98.40% confidence level. Negative coefficients were due to participants’ unfamiliarity of specific techniques used with teamwork activities. Therefore, it can be deduced that teamwork becomes more prevalent when more progress is made with the Lean process.

**H2:** The more progress is made with the Lean process, the more horizontal integration and cross-functional teamwork will occur. Was highly significant with positive coefficients for 15 of the 19 Lean techniques, with a regression equation of:

\[
LHINT = 0.373 + 0.005HOSK + 0.013POLDEP - 0.051DISTVAL + 0.0547W - 0.058PROB + 0.313KAIZ + 0.3495S - 0.004TAG - 0.087CTR + 0.005SMED - 0.061VSM + 0.049CM - 0.037SPF - 0.130POKJID + 0.006KAN + 0.214HEIJ + 0.037VIS + 0.089TPM + 0.195STAND
\]
Supported by: R squared = 0.72, standard error = 0.859, F – statistic = 26,8345, Durbin-Watson Statistic = 1,950, critical F = 1,641 at a 98.40% confidence level. Negative coefficients were due to the unfamiliarity of participants with the specific techniques with respect to cross-functional teamwork and the degree and type of horizontal integration in the organisation.

H3: The more progress is made with the Lean process, the lower will be the locus of decision-making, indicating more effective self-directed team activity at lower organisational levels. Was significant with positive coefficients for 10 of the 19 Lean techniques, with a regression equation of:

\[
\text{LOCDM} = 3,304 - 0,220\text{HOSK} + 0,0,061\text{POLDEP} + 0,215\text{DISTVAL} - 0,0807\text{W} - 0,009 \\
\text{PROB} + 0,176\text{KAIZ} - 0,0435\text{S} - 0,019\text{TAG} + 0,119\text{CTR} - 0,148\text{SMED} + 0,041\text{VSM} - \\
0,036\text{CM} + 0,140\text{SPF} - 0,085\text{POKJID} - 0,032\text{KAN} - 0,405\text{HEIJ} + 0,074\text{VIS} + 0,008\text{TPM} \\
-0,077\text{STAND}
\]

Supported by: R squared = 0.4828, standard error = 0.859, F – statistic = 26,8345, Durbin-Watson Statistic = 1,950, critical F = 1,641 at a 98.40% confidence level. Negative coefficients were due to the unfamiliarity of participants with the specific techniques with respect to self-directed teamwork and low level decision-making that had occurred in the organisation.

H4: The more progress is made with the Lean process, the more participation and involvement of employees will occur, resulting in more teamwork. Was highly significant with positive coefficients for 15 of the 19 Lean techniques, with a regression equation of:

\[
\text{PARTINV} = 0,322 + 0,345\text{HOSK} + 0,0,071\text{POLDEP} + 0,004\text{DISTVAL} + 0,1447\text{W} - \\
0,056\text{PROB} + 0,193\text{KAIZ} + 0,290\text{S} + 0,070\text{TAG} + 0,134\text{CTR} - 0,295\text{SMED} + 0,030 \\
\text{VSM} + 0,123\text{CM} - 0,056\text{SPF} - 0,168\text{POKJID} - 0,053\text{KAN} + 0,078\text{HEIJ} + 0,145\text{VIS} + \\
0,109\text{TPM} + 0,079\text{STAND}
\]

Supported by: R squared = 0.80, standard error = 0.824, F – statistic = 40,046, Durbin-Watson Statistic = 2,107, critical F = 1,641 at a 98.40% confidence level. Negative coefficients were due to the unfamiliarity of participants with the specific Lean flow techniques, when people participated in teamwork activities and type of participation and involvement that had occurred in the organisation.

H5: The more progress is made with Lean flow techniques; the more cellular manufacturing will develop, leading to more self-directed teamwork in cells. Was significant with positive coefficients for 10 of the 19 Lean techniques, with a regression equation of:

\[
\text{CELFM} = 2,224 + 0,333\text{HOSK} - 0,166\text{POLDEP} + 0,004\text{DISTVAL} + 0,1917\text{W} - 0,043 \\
\text{PROB} - 0,382\text{KAIZ} - 0,009\text{S} + 0,018\text{TAG} - 0,175\text{CTR} - 0,221\text{SMED} + 0,053\text{VSM} - 0,077 \\
\text{CM} - 0,010\text{SPF} + 0,359\text{POKJID} + 0,084\text{KAN} + 0,274\text{HEIJ} - 0,061\text{VIS} + 0,056\text{TPM} - 0,066 \\
\text{STAND}
\]

Supported by: R squared = 0.47, Standard error = 0.9407, F – statistic = 7,3784, Durbin-Watson Statistic = 1,399, critical F = 1,664 at a 98.40% confidence level.
Negative coefficients were due to the unfamiliarity of F01 participants with the specific Lean flow techniques, however, countered by the strong self-directed teamwork structure evident at the W01 plant when people participated in self-directed teamwork activities.

The analyses above indicated significant interrelationships strongly supported and confirmed by the qualitative analysis.

4.2. Qualitative analysis

The two cases are discussed next, followed by the qualitative findings and analyses.

4.2.1. Case study F01

A USA-listed pump-engineering organisation with 2,700 employees worldwide and about 150 in South Africa. Up to 2006, they acted as traders of electric motors, pumps and spares in South Africa; however, it has since become a manufacturing organisation. It was achieved through the purchase of a going concern that belonged to the South African engineering group. The current facility on the East Rand consists of three factories: a rubber plant, machine shop, and a chroming plant. Under the USA management, F01 adopted a Lean transformational strategy. The managing director, plant, engineering and export manager were replaced during 2012 with individuals who have an appreciation for Lean thinking. Since September 2012, the plant manager has fulfilled a key role in driving the Lean initiative. The F01 organisation uses a matrix structure for the worldwide organisation, which is shown in Appendix 1 and the operational structure of F01 in Appendix 2.

The structures portrayed in Appendices 1 and 2 show the reporting relationships for F01 with dotted lines (Appendix 1) indicating matrix links. Commencing with five-S, the organisation is currently focused on establishing manufacturing cells for the total facility including warehouse and distribution. Lean progress has been substantial with organisational learning being experienced from team processes, and three manufacturing cells have been implemented.

4.2.2. Case study W01

A large facility on the East Rand, the largest aluminium extrusion organisation in Africa, and owned by a large investment organisation listed on the Johannesburg stock exchange (JSE). The organisation, with 1,100 employees, is comprised of an aluminium extrusion, scrap and binning, re-melt, powder coating and anodising plant. Following major restructuring in 1998, the organisation adopted a Lean initiative in 2002 in the form of the 20 keys processes. Five-S was applied to clean up the organisation, and all the employees were involved in the exercise. The total organisation has been set up as a continuous flow line: the binning operation supplying the re-melt manufacturing cell that in turn supplies the extrusion manufacturing cells of four press extrusion lines. The extrusion operation supplies the anodising and powder coating manufacturing cells. The finished products are despatched to the Gauteng stockist organisation that acquired two distribution organisations, one in 2007 and the other in 2011. Their current organisational structure is shown as the top structure in Appendix 3 and the operations structure is shown in Appendix 4.
Appendix 4 demonstrates an effective Lean structure as per Haug (2008) of first-line managers running mini-business teams within a business unit with support functions of die correctors and maintenance specialists allocated directly to a particular cell. Support teams collect processed items from the cell and move same to downstream units’ Kanbans. The findings from the qualitative data analysis are discussed next.

4.3. Qualitative analysis – replicated patterns identified for F01 and W01

The following findings are the replicated patterns per proposition (refer Table 2) identified from the analysis of the qualitative data. The pattern codes distinguish the cases in coding as: case code (F or W); proposition number; pattern number (Px). The propositions are discussed per main proposition per case and per sub-proposition.

4.3.1. Main proposition one (MP1)

**FO1**: A high level of resistance was experienced when Lean implementation commenced in 2013. New management replaced previous management and enforced a Lean process. Dismissals of shop stewards occurred (P1). The top team has taken on the role of coordinating the Lean process for the total organisation assisted by the corporate Kaizen team (P2). Five S was implemented for the total organisation. Operations employees are fully trained in basic Lean thinking. Early evidence of cellular manufacturing was established by cross-functional teams. Sales, engineering and manufacturing teams configure assembly orders (P3). Productivity has improved from 40% to 76% measured with standard time compared to actual time taken on productive work over a period of one year, and on-time delivery from 40% to 62%, measured by comparing customer accepted due dates to actual delivery dates over a period of one year (P4).

**WO1**: Employees resisted change in the late 1990s and early 2000s due to changes involving the Lean process and restructuring. Poor performing management were replaced and some workers retrenched (P1). Top management enforced new roles for managers retained after restructuring. Consultants assisted with the Lean process and changes (P2). Team structures of a business development team coordinating the Lean process using 20 keys, mini-business flow-line teams, and vertically and horizontally integrated teams work on organisational issues. All departments operate as teams supporting the Lean process (P3). They have won the national productivity award twice in a row; achieving 19.5% profit before interest and tax to sales. All deliveries take place within three days (P4).

4.3.2. Main proposition two (MP2)

**FO1**: The plant manager has implemented green areas with meetings, involving all the manufacturing, distribution, and warehouse employees (P1). Green areas’ teamwork occurs with discussions involving production output and quality (P2). Supervisors are empowered with purchasing authorisation levels previously reserved for senior management (P3). There is a quarterly tank talk by the managing director involving all the employees with feedback (P4). Lean awareness is due to the five-S activities area and departmental teams working together cleaning and organising (P4). The plant manager works to create self-directed teams. The export team is virtually fully self-directed (P5). Employees and
managers work in a cross-functional team to create cellular manufacturing (P6). Positive attitudes were evident as was observed and recorded during the interviews with individuals of the organisation, who were positive commenting on the progress Lean had made. Team members were becoming more affectively committed with open sharing of ideas and being recognised by the organisation for their contributions (P7).

WO1: The organisational development unit works at developing first-line managers to understand Lean, 20 keys fully (P1). First-line managers are facilitating mini-business team meetings in special clean team areas and do training in 20 keys (P2). Workers are empowered through multi-skilling and to run cells and Kanbans in self-directed teams (P3). The managing director initiated the joint leadership meeting: employees invited; organisational performance discussed; feedback from workers responded to (P4). Workers in mini-business teams are providing ideas for the Kaizen activity, example of a remarkable die design idea by a die corrector (P5). The cross-functional team unit, operations and first-line managers ensure complete downward communication to first-line managers and upward communications from the first-line managers twice weekly (P6). Teamwork in all areas has led to active and focused participation by team members. Permanent teams of the organisational development team of the organisation assist the departmental teams and the flow-line teams (mini-business teams) to improve and sustain the Lean process (P7).

4.3.3. Sub-proposition one (SP1)

FO1: Workers sense the benefits of teamwork, as was recorded in the interviews since ideas shared generate commitment, appreciation, and rewards. A quarterly feedback meeting from the managing director keeps all in the organisation abreast of progress (P1). The organisation is learning with corporate Kaizen team forming teams with employees from different departments to implement improved flow and workplace areas (P2). All managers are open to and supportive of their staff joining cross-functional teams when required. Cross-functional interactions are not discouraged (P3). Supervisors are being developed as a powerful resource and have been given signing authority normally reserved for management. Team members make decisions previously reserved for managers (P4).

WO1: Workers see the benefits being aware of the improved financial performance of the organisation as a result from the world-class performance of the organisation and working in teams, with supportive, caring leaders. Lean techniques implementation is seen as progress that is linked to gain sharing (P1). Lean training is provided continuously by the organisational development team. First-line, flow-line managers, focus on the Lean process in daily team meetings (P2). All managers are open to and supportive of their staff joining cross-functional teams when required (P3). First-line managers are well developed as a powerful resource leading team sessions. Team members are given opportunities to lead the team and are utilised to analyse and record data on board graphs (P4).

4.3.4. Sub-proposition two (SP2)

FO1: 64% of the employees interviewed commented that people were participating because they had a better understanding of what was expected of them. They added that they were improving with five-S, green areas and Kaizen team participation and that they were learning more, the more they participated in team sessions (P1). Since
September 2012, there was employee involvement through Kaizen projects with support from the USA Kaizen team involving employees from engineering, manufacturing, industrial engineering in a cross-functional team (P2). Workers in teams become more affectively committed as suggested by the comments from supervisors who had developed four manufacturing cells with teams (P3).

**WO1:** Management and employees acknowledge that team sessions lead to more involvement, and learning, also the benefits that have been gained. Through teamwork, recognition is received through certificates and bonuses, and team information sessions provide information regarding where the organisation is going (P1). There is evidence of the top team working cross-functionally in teams with employees implementing best practice flow lines for the extrusion lines, powder coating flow lines and anodising flow lines (P2). Workers as team members proved their high level of affective commitment and provided a competitive edge to the organisations with unique idea implementations of new methods, such as a die design that enables die changes in rapid succession and high-frequency loading of furnaces that enables quicker product mix turnaround (P3).

### 4.3.5. Sub-proposition three (SP3.1 and 3.2)

**FO1:** All departments have become involved in a five-S clean-up programme with regular audits by the quality assurance department. An idea box reward system has been implemented to encourage Kaizen participation (P1). The corporate Kaizen team with a cross-functional team involving all functions have set the example of using all the basics of problem solving, with flow techniques to implement a pull system between assembly and warehouse (P2).

**WO1:** All departments have become involved in a five-S clean-up programme. Regular audits by an organisational development expert in 20 keys are being done in order to determine five-S status. Employees work together as a team in each department to perform in the five-S (key 1) programme. All employees have been trained in the 20 keys process, and there is a high level of awareness in the elimination of wastes (P1). Lean techniques applied in all departments has provided accounts feedback within three days, improved flow in powder coating using value stream mapping and improved flow in bailing using an automated bailing machine (P2).

### 4.3.6. Sub-proposition four (SP4)

**FO1:** Commenced with departmental teams implementing five-S and stimulated idea generation by encouraging employees to participate in an idea box process. Manufacturing green area teams were working on five-S and Kaizen improvements and manufacturing cell teams were becoming more self-directing (P1).

**WO1:** Departmental teams work mainly on Lean techniques such as Kaizens, five-S, standard operating procedures for the department, and waste reduction. Cross-functional teams have implemented cellular manufacturing for the total organisation utilising single minute exchange of die (SMED), cycle-time reduction, value stream mapping, and partial total productive maintenance processes. Mini-business teams have become highly skilled, and they are improving the flow using Kaizen (P1).

### 4.3.7. Sub-proposition five (SP5.1 and 5.2)

**FO1:** Manufacturing employees have been trained in Kaizen techniques such as the five why’s, and engineering employees have a good understanding, as was established from a
team meeting that was held during the research period. Most teams, including departmental teams, cross-functional teams and work teams (Green area teams) are aware of the technique (P1). The plant manager has initiated Hoshin Kanri for the total organisation and was assisted by the top management team. Each employee has been given an objective or objectives related to his or her respective function or task (P2). The corporate Kaizen team worked with a cross-functional management team to develop a special pump assembly cell utilising all the flow techniques. This assembly cell is able to deliver customers’ orders within one day of receipt of order (P3). The plant manager is focused on empowering supervisors as is especially evident from the cell implementation and Kaizen work done by the rubber and rotor shop supervisor and the assembly supervisor (P4).

**WO1**: All established teams use problem solving on a continuous basis (P1). Hoshin Kanri and policy deployment are effectively applied with the organisational development teamwork at setting team goals and objectives by team in conjunction with top management team (P2). Early manufacturing cell development was initiated by the top management team visiting overseas countries to obtain best practice flow line information. The current plant is set up as linked cells: one manufacturing cell is linked to the next (P3). Continuous flow has been achieved and is being improved on. Skips development for Kanban pull implemented for all cells involving the extrusion, powder coating and anodising. SMED is implemented for most manufacturing cells. Three-minute exchange of die has been achieved for the extrusion manufacturing unit, which makes one-piece flow possible as for the anodising cell that has a set-up time of seconds. Similar to Heijunka, all customers’ orders are scheduled in sequence and delivered to the next production unit within one day of receipt of order (P4). There is evidence of the use of value stream mapping by the powder coating work teams working in a team with a university student to redesign the next manufacturing cell (P5). There is evidence from the interviews with first line managers, toolmakers, and team members of flow line teams, of effective cross-functional teamwork between toolmakers and first-line managers leading cellular work teams. This has led to the successes of set-up time reduction achieved (P6). There is evidence that work teams are updating their own standard operating procedures (P7). There are significant indications that work teams are working virtually fully self-directed under the leadership of effective first-line managers (P8).

**4.3.8. Sub-proposition six (SP6)**

**FO1**: A top team meeting during the research identified the future direction of the organisation, indicating the way forward with the appointment of a Lean champion to accelerate the Lean process (P1). The appointment of an industrial engineering manager as Kaizen champion is an initiative that is supporting the Lean process positively (P2). There is strong evidence from three distinct work-studies that had been initiated by the Kaizen team in the United States and the plant manager, of effective cross-functional teams participating in Kaizen projects to improve the flow with new manufacturing cells being developed and more work teams being empowered to promote flow (P3). There is evidence of a new culture emerging for FO1 with respondents identifying that a team-work culture had been established for the organisation (P4).
WO1: There is evidence of a mature Lean organisation with fixed departmental, cross-functional teams and self-directed work teams named mini-business teams led by highly skilled and competent first-line managers (P1). The development team continues with impact projects for improvement. The current focus is on improved maintenance (TPM) with manufacturing cell teams working with maintenance specialists to improve equipment condition (P2). The current structure resolves cross-functional issues in a routine twice-weekly cross-functional team meeting consisting of all business units up to operations management level. First-line managers meet daily with their teams in clean areas specially established for the work teams. Work teams work on flow, or man the different manufacturing cells; supply team teams take work from cells and deliver to skips as Kanbans equipped for the downstream cells. Tooling and maintenance specialists assist the first-line managers and their teams. Team members schedule customer orders in date sequence with one-day delivery between manufacturing units (P3).

4.3.9. Contribution to new knowledge
The patterns discussed above clearly show effective replication and provide a way to define new guidelines for team formation with Lean transformations.

The outcome of this research is of major significance for organisations wishing to embark on a Lean transformation as it clearly points to how and why teamwork evolves with a Lean transformation.

The contribution to the literature is that teams will evolve from manufacturing cells being established, being run by highly competent team members led by highly skilled first line managers. Running these manufacturing cells as small businesses motivates team members and leads to on-going commitment and continuous improvement within the cells.

5. Conclusion
In this article, the authors addressed team formation in Lean organisational transformations. They highlighted the lack of literature regarding how and why team formations materialise with Lean implementation and pointed out that not many success stories can be written regarding successful Lean transformations and how teamwork should evolve during and after transformations.

Limitations existed for this research due to limited available study sites. Choosing compelling case studies, required the assessment of behaviour at organisational level, and this may have resulted in subjective responses from individuals. In order to counteract this, the researchers made use of the units of research to check the views of individual participants when bias was suspected. Furthermore, the use of questionnaires and assessment surveys may have resulted in resistance on the part of individuals or groups because of the infringement on normal work time and space, and concerns related to organisational transformation. However, this concern was counteracted to a great extent by the positive manner in which top management and individuals supported the research process. Furthermore, it should be noted that the quantitative work should not be regarded as generalizable for discrete Lean organisations and was done to support the case studies in this research; however, the case study goes a long way to
identify the pertinent underlying aspects related to team formations and development in discrete manufacturing organisations pursuing a Lean strategy.

The significance and contribution of this research has been to articulate new guidelines for team formations with Lean transformations, which may prove invaluable to organisations wishing to embark on a Lean journey. The guidelines from the research indicate that successful organisations commence with a defined Lean strategy that accounts for people involvement and team formations.

Top teams initiate team-building processes: firstly, as cross-functional project teams addressing the more basic techniques such as five-S and workplace reorganisation and moving on to the more complex flow techniques such as SMED, value stream mapping and cellular manufacturing and permanent flow-line. Self-directed work teams emerge together with charismatic team leaders, developed with the implemented flow-lines as manufacturing cells. The top team maintains team processes as ingrained practices and standards, supported by flow-line teams who develop their own work standards. Specialists who are allocated to the flow-line teams from functional units assist flow-line teams. From this process, team members develop new skills based on the examples set by these allocated specialists. An important observation is that continuous flow is seen as an imperative for rapid and effective Lean transformations. This is in support of Myerson (2013) who identified that if top management plays a supportive role, everyone is participating and communication and training are prevalent, then success in Lean will be achieved.

The recognition that continuous flow is the ultimate achievement of an organisation is demonstrated by F01’s early acknowledgment of manufacturing cells and work teams. Similarly, continuous flow was achieved by W01, utilising manufacturing cells led by highly skilled first line managers. It is recommended strongly, therefore, that organisations embarking on a Lean transformational strategy consider, in parallel to the simpler housekeeping techniques, that rigorous flow-line planning be elevated early on in the Lean journey. Current and future value stream mapping involving more than a specialist group should, therefore, be a strategic imperative.

The effect of charismatic flow-line team leaders (first-line managers at W01) should also not be underestimated and the development of these individuals is seen as a prerequisite for successful Lean transformations. This aspect is particularly important in W01, where it was regarded as vital for both the implementation and Kaizen or continuous improvement phase of the Lean process. Regarding the development of charismatic flow-line leaders in terms of Kaizen, as discussed in W01, the use of their Lean champion and her team provides further support for the Lean process.

For effective Lean transformations, team formations should, therefore, include a Lean champion leading a team of Lean specialists that would normally be allocated to either cross-functional or self-directed flow line teams. These specialists would actively participate in the employee-development processes.

The question whether Toyota has lost its way is answered in a final recommendation from this research. Humble and constructive leadership is vital, not only for effective Lean transformations but also for the employee development so that the organisation can continuously improve on its achievements. This lesson comes to us from Africa in the form of two case studies, which yielded guidelines for team formations within the Lean process. However, the observation that literacy remains a constraint for South
African organisations poses an opportunity for future research, especially in terms of the development of employees who, despite this issue, remain affectively committed to Lean process.

**Disclosure statement**

No potential conflict of interest was reported by the authors.

**References**

Angelis, J., Conti, R., Cooper, C., & Gill, C. (2011). Building a high-commitment lean culture. *Journal of Manufacturing Technology Management*, 22(5), 569–586.

Boyle, T. A., Scherrer-Rathje, M., & Stuart, I. (2011). Learning to be lean: The influence of external information sources in lean improvements. *Journal of Manufacturing Technology Management*, 22(5), 587–603.

Brown, C. B., Collins, T. R., & McCombs, E. L. (2006). Transformation from Batch to Lean manufacturing: The performance issues. *Engineering Management Journal*, 18(2), 3–14.

Caliskan, N. (2016). Teamwork the Lean way. *European Journal of Business, Economics and Accountancy*, 4(6), 28–31.

Cameron-Strother, A. H. (2009). The causal relationship inherent in the alliance of lean infrastructures, employee engagement, leadership impact, and team dynamics in modern manufacturing environments (Unpublished PhD-thesis). Capella University: Minneapolis.

Coetzee, R., Van der Merwe, K., & Van Dyk, L. (2016). Lean implementation strategies: How are the Toyota way principles addressed. *South African Journal of Industrial Engineering*, 27(3), 79–91. Special Edition.

Cooper, J. J. (2011). *The integral role of organisational characteristics and their impact on lean implementation success* (Unpublished PhD-thesis). Southern Illinois University, Carbondale.

De Vries, H., & van der Poll, H. M. (2016). The influence of lean thinking on organisational structure and behavior in the discrete manufacturing industry. *Journal of Contemporary Management*, 13, 55-89.

Eye Witness News. (2015). Toyota recalls 6 million cars globally. Retrieved from http://m.ewn.co.za/2015/10/21/Toyota-recalls-6-million-cars-globally

Fortune Global 500. (2010). How Toyota lost its way. *Toyota recall crisis*. Retrieved from http://archive.fortune.com/2010/07/12/news/international/toyota_recall_crisis_full_version.fortune/index.htm

Gagnon, M. A. (2004). Investigating employee strategic alignment during a transformation to lean manufacturing (Unpublished PhD-thesis). Pennsylvania State University, Philadelphia.

Gander, M. J. (2009). Managing people in a lean environment: The power of informal controls and effective management of company culture. *Journal of Business Case Studies*, 5(6), 105–110.

Grütter, A. (2004, June). *The truth about shop floor teamwork*. Paper presented at SAPICS 26th Annual Conference and Exhibition in Cape Town, South Africa.

Grütter, A. W., Field, J. M., & Faull, N. H. B. (2002). Work team performance over time: Three case studies of South African manufacturers. *Journal of Operations Management*, 20(5), 641–657.

Harris, C. M. (2007). An extension of a three component model of organisational commitment to the area of commitment to organisational change in facilities implementing Lean Production (Unpublished DBA-thesis). Anderson University, Anderson.

Haug, P. (2008, November). *Value stream management: Empirical evidence on lean organizational structures*. Paper presented at the 39th conference of annual meeting, Baltimore State. Decisions Science Institute.

Haug, P. (2012). *Value stream management: Empirical evidence on lean organizational structures*. Retrieved from http://decisionsciences.org/Proceedings/DSI2008/docs/47-6897.pdf

Hettler, N. (2008). Lean means business. *Manufacturing Engineering*, 140(1), 103–109.
Johnson, J. M. (2009). Leadership and organisational performance in a global, “Fortune” 500 Six Sigma operating company: a correlational research study (Unpublished PhD-thesis). Capella University, Minneapolis.

Jones, D. T. (2006). Heijunka: Levelling production. Manufacturing Engineering, 137(2), 29–36.

Jumara, J. J. (2005). A case study of the influence of organization theory on organizational change (Unpublished PhD-thesis). University of Missouri, Kansas City.

Kent, T. W. (2006). A process for identifying the skills needed for operating in a self-directed work team in a manufacturing setting. Team Performance Management, 12(7/8), 258–271.

King, G., Keohane, R. O., & Verba, S. (1994). Designing social inquiry: Scientific inference in qualitative research. Princeton: Princeton University Press.

Kucner, R. J. (2008). A socio-technical study of lean manufacturing deployment in the remanufacturing context (Unpublished PhD thesis). University of Michigan, Ann Arbor, Michigan, United States.

Lander, E. (2007). Implementing Toyota-style systems in high variability environments (Unpublished PhD thesis). University of Michigan, Ann Arbor Michigan.

Losonci, D., Demeter, K., & Jenei, I. (2011). Factors influencing employee perceptions in lean transformations. International Journal of Production Economics, 131(1), 30–43.

MacKenzie, A. (2010). Toyota recall crisis. Retrieved from http://www.motortrend.com/features/auto_news/2010/112_1001_toyota_recall_crisis/viewall.htm

Meredith, J. (1998). Building operations management theory through case and field research. Journal of Operations Management, 16(4), 441–454.

Mostafa, S., Dumrak, J., & Soltan, H. (2013). A framework for lean manufacturing implementation. Production & Manufacturing Research, 1(1), 44–64.

Mostafa, S., Lee, S., Dumrak, J., Chileshe, N., & Soltan, H. (2015). Lean thinking for a maintenance process. Production & Manufacturing Research, 3(1), 236–272.

Myerson, P. A. (2013). We’re all in this together: Teamwork in a Lean workplace. Retrieved from http://www.inboundlogistics.com/cms/article/were-all-in-this-together-teamwork-in-a-lean-workplace/.

Nahm, A. Y., Vonderembse, M. A., & Koufteros, X. A. (2003). The impact of organisational structure on time-based manufacturing and plant performance. Journal of Operations Management, 21(3), 281–306.

O’Carroll, R. (2004). Designing organisations to survive in the global economy: An insider’s account. The Irish Journal of Management, 25(2), 76–91.

Ôhno, T. (1988). Toyota production system: Beyond large-scale production. Portland: Productivity Press.

Oropesa Vento, M., García Alcaraz, J. L., Maldonado Macías, A. A., & Martínez Loya, V. (2016). The impact of managerial commitment and Kaizen benefits on companies. Journal of Manufacturing Technology Management, 27(5), 692–712.

Pinheiro, R. E. (2010). Organisational change and employee empowerment - a grounded theory study in lean manufacturing integration into a traditional factory environment (Unpublished PhD-thesis). Capella University, Minneapolis.

Poppendick, M. (2002). Principles of lean thinking. Retrieved from www.gregoryneilassociates.com/articles/lean_thinking.pdf

Quarterman, L. (2007). Implementing lean manufacturing. Management Service, 51(3), 14–19.

Rother, M. (2011). What is lean teamwork? Retrieved from http://theteamleanedge.org/?p=2877

Rother, M., & Shook, J. (2003). Learning to see: Value-stream mapping to create value and eliminate muda. Cambridge: Lean Enterprise Institute.

Sawhney, R., & Chason, S. (2005). Human behaviour based exploratory model for successful implementation of Lean enterprise in industry. Performance Improvement Quarterly, 18(2), 76–96.

Tress, E. P., & Espinoza, A. B. (2012, May). The human side of Lean manufacturing: A successful model implementation. Paper presented at the IIE Annual Conference, Orlando.

Van der Merwe, K. R., Pieterse, J. J., & Lourens, A. S. (2014). The development of a theoretical Lean culture causal framework to support the effective implementation of Lean in automotive component manufacturers. The South African Journal of Industrial Engineering, 25(1), 131–144.
Vermaak, T. D. (2008). Critical success factors for the implementation of Lean thinking in South African manufacturing organisations (Unpublished DCom-thesis). University of Johannesburg, Johannesburg.

Wickramasinghe, D., & Wickramasinghe, V. (2011). Effects of perceived organisational support on participation in decision making, affective commitment and job satisfaction in lean production in Sri Lanka. Journal of Manufacturing Technology Management, 23(2), 157–177.

Womack, J. P., & Jones, D. T. (2007). The machine that changed the world. London: Simon & Schuster.

Womack, J. P., & Jones, D. T. (2010). Lean thinking: Banish waste and create wealth in your corporation. New York: Free Press.

Yin, R. K. (2014). Case study research: Design and methods (5th ed.). Thousand Oaks: Sage.

Appendices

Appendix 1. F01 organisational structure (Source: Authors’ own depiction of F01’s organisational structure)
Appendix 2. F01 operations structure (Source: Authors’ own depiction of F01’s operations structure)
Appendix 3. W01 organisational structure (Source: Authors’ own depiction of W01’s organisational structure)
Appendix 4. Organisational structure for W01 operations (Source: Authors’ own depiction of W01’s operations structure)