ORIGINAL ARTICLE

Lean in healthcare: Engagement in development, job satisfaction or exhaustion?

Pernilla Lindskog*[1], Jens Hemphälä[2], Jörgen Eklund[1], Andrea Eriksson[1]

[1]*KTH Royal Institute of Technology, School of Technology and Health, Sweden*
[2]*KTH Royal Institute of Technology, School of Industrial Engineering and Management, Sweden*

ABSTRACT

Conclusions about implementing the management concept lean in healthcare are contradictory and longitudinal studies are scarce. In particular, little is known of how working conditions contribute to the sustainability of lean in healthcare. The aim of this article is to identify to what extent lean tools (visual follow-up boards, standardised work, 5S [housekeeping], and value stream mapping [VSM]) promote working conditions for employees and managers in healthcare organisations (outcomes: engagement in development, job satisfaction and exhaustion), while considering the context (i.e., job resources and job demands) and aspects of the implementation process. A longitudinal quantitative study was conducted that involved employees and managers in two hospitals and one municipality (n = 448). Applying the job demands-resources model, multiple linear regression models were used. VSM, standardised work and 5S promoted employees and managers' working conditions when supported by job resources. When no support was provided, visual follow-up boards were inhibiting employees and managers' job satisfaction. VSM and standardised work were seen as central lean tools. In this sample, the application of lean cannot be considered sustainable as employees and managers' working conditions deteriorated under the implementation of lean.

Key Words: Employees, Managers, Work environment, Job demands-resources model, Sustainability

1. INTRODUCTION

Higher demands upon efficiency and rationalisation have long been seen in the healthcare sector,[1–4] including Swedish healthcare.[5, 6] Consequently, many organisations in this sector have introduced concepts inspired by private sector rationalisation concepts in order to become more efficient and effective (cf. the New Public Management).[7–9] An example of such concept is lean production (lean),[10, 11] originating from Toyota's car production and later termed "lean" production,[12] that has spread globally.[13, 14]

Although definitions of lean vary,[15] a common understanding is that it is an integrated socio-technical work system[16] whose main objective is to eliminate waste, reduce non-value added activities, and maximise customer benefits in organisations and their processes.[10, 11, 17] From a socio-technical perspective, an emphasis has been placed on the importance of including contextual factors and information about the implementation process to understand the different outcomes of lean implementation in healthcare.[18, 19] Lean implementation has been related to increased job demands and decreased resources,[20] and other studies have pointed out difficulties in engaging employees in lean.[21, 22] Most of the criticism around lean concerns the work environment (i.e., work intensification, increased management control, and the negative

impact on employee health).[20, 23, 24] A suggestion has even been raised that the widespread implementation of lean is a result of managers' decisiveness in developing the organisation according to stakeholders' expectations,[25] and that lean in healthcare most likely will become a fad.[26] However, other identified outcomes from lean implementation appear to be positive impacts on working conditions[18, 27, 28] and productivity.[29–31]

In general, it has been outlined that studies of process redesign (e.g., lean) in healthcare include unsatisfactory methodologies, and consequently available results are claimed to be inconclusive[14] or contradictory.[18] What is more likely is that lean may have both positive and negative effects on organisations during implementation,[32] depending on the implementation process and the context in which lean is implemented.[18, 19] For example, a successful implementation process was positively related to improved psychosocial work conditions, while an unsuccessful implementation process seemed to have adverse effects.[18]

The ambiguity regarding the concept and the fact that only a few organisations have seemingly achieved the expected result following implementation[33–35] — many efforts to change and develop organisations generally fail[1, 36, 37] — could be the reason why organisational development, such as lean, is seldom defined as sustainable.[14] Sustainable organisational development is about optimising both organisational performance, including economic results, and good working conditions[38, 39] (the ecological aspect of the sustainability definition at a political macro level[40] is not the focus in this study). Greater attention to working conditions and well-being, or basic human resource management, is said to benefit the pursuit of higher quality and more efficient healthcare through process redesign such as lean.[14]

Therefore, the aim of this article is to identify to what extent lean tools (visual follow-up boards, standardised work, 5S [housekeeping], and value stream mapping [VSM]) promote working conditions for employees and managers in healthcare organisations (outcomes: engagement in development, job satisfaction and exhaustion), while considering the context (i.e., job resources and job demands) and aspects of the implementation process.

2. FRAME OF REFERENCE AND METHODOLOGICAL CONSIDERATIONS

A lean context of downsizing will likely generate different effects than a context based on employee participation as a job resource:[24, 41, 42] top-down initiated development work may often be regarded with mistrust by healthcare professionals.[43] This also applies to lean implementation.[44] However,

studies on the lean context, including job resources, contributing to both engagement and employee well-being during lean implementation are still scarce.[18, 19] Furthermore, the deficiency in previous knowledge has been criticised for a lack of theoretical job-design models.[19, 29]

Karasek's job demand-control model (JD-C model)[45, 46] has been a focal point in assessing the effects upon health and well-being at work, but this model has been questioned for not being as valid in present work contexts.[25] For example, employees perceiving a reduced level of autonomy may still be motivated and engaged in lean if that perception is accompanied by other job design factors that compensate for this lack of autonomy.[29] Thus, an open and flexible analysis model has been suggested[32, 37] — similar to the job demands-resources (JD-R) model[47] — in order to capture lean's complex socio-technical character.[16, 48] The JD-R model describes the importance of job resources developed to enable employees to handle the current demands at work.[47] Job resources positively correlate to employee engagement and job demands positively correlate to employee exhaustion, according to the hypothesis. Hence, the JD-R model explains outcomes such as engagement, exhaustion, job satisfaction, and work performance by allowing various contextual conditions.[32, 47, 49–51] Additionally, this model was recently used in capturing the duality of lean and its consequent effects on engagement and worker health.[32]

2.1 Job demands and job resources

With regard to sustainable[52] implementation of lean,[38, 39] this study is based upon the assumption that job resources and job demands impact healthcare employees' engagement in development, job satisfaction and exhaustion. From this assumption, the JD-R model was deemed a suitable analysis model and the selection of critical job resources was based upon previous research, which included a qualitative study that identified job resources affecting the lean implementation in psychiatry healthcare in Sweden.[53] Job security, development resources, job control, role clarity, and participation were selected as job resources.

2.1.1 *Job security*

Job security (i.e., psychological safety and personnel stability) is regarded in the context of this study as an important resource. Insecurity in rationalisation processes, parallel to the lean implementation, has been shown to hinder lean implementation in the public sector.[21, 44, 54]

2.1.2 *Development resources*

Sufficient development resources have been shown to be critical for successful healthcare implementation of development work.[55] For example, research shows that lack of time

and opportunities for discussions with colleagues inhibited nurses from becoming involved in development work.[56] We define development resources as time and resources for testing new ideas at work.[57–59]

2.1.3 *Job control and role clarity*

Operative healthcare managers are key actors in implementing development work.[53,60,61] Lindskog et al. revealed that healthcare first-line managers perceived a lack of power and authority (job control), which resulted in unclear roles for these managers and had negative effects on their participation in the lean implementation.[53] Hence, job control and clear roles may be specifically important for healthcare managers but the assumption is that these factors may be equally important for employees. For example, at The Virginia Mason hospital, which is known for successful implementation of lean,[30] roles and expectations are explicit, and managers seek to clarify expectations, responsibilities and accountabilities. This underpins the need to promote clarity in the form of clear roles during lean implementation.

2.1.4 *Participation*

Previous research suggests that socio-technically-oriented principles such as organisational democracy, participation and autonomy need to be present in order for lean to be sustainable.[62–64] This is especially true in healthcare organisations.[53] Eklund et al. demonstrated that companies with a higher level of participation during the implementation of the lean tool standardisation performed better and also witnessed higher employee engagement.[65] Similar results were shown in healthcare: Winkel et al. concluded that participatory approaches in VSM enable employee involvement in hospitals.[66]

2.1.5 *Job demands*

In this study, job demands are operationalised as an excessive workload. Hence, in order to promote engagement in development and job satisfaction, while not promoting employee exhaustion, the job demands must be balanced against the job resources.[47]

2.2 Lean tools

Lean in healthcare is commonly defined as process improvement work,[67,68] and in order to improve healthcare work processes the Swedish public sector uses a variety of lean tools.[28,69] Commonly applied tools include standardised work,[70] 5S, visual follow-up boards, and VSM.[71]

2.2.1 *Visual follow-up boards*

Visual follow-up boards are claimed to make organisations' processes and roles more clear and understandable, facilitate employee participation in continuous improvement activities, and increase employees' capacity for decision-making.[72]

Furthermore, this lean tool may also be used to support on-going strategy, and facilitate performance measurements and review.[73]

2.2.2 *Standardised work and housekeeping*

Standardised work is one of the key components of lean,[70] and aims to achieve a clear, accepted and most efficient way of working, ultimately providing a standard from which improvements will result.[74] 5S (housekeeping) is also considered a form of visual monitoring and standardisation,[75,76] and its purpose is to organise and equip the workplace in order to, for example, establish where different working aids should be stored when not in use and to efficiently carry out daily tasks in a safe manner.

2.2.3 *Value stream mapping*

In VSM[66,77] employees map or chart the operations, analyse the value flow, and identify actions needed in order to remove non-value added activities and make work flow more smoothly (i.e., shortening the process lead time). In this way, the work process becomes clear and the roles and actions of individuals can be understood in a larger organisational context. As such, VSM is deemed to promote clarity in the organisation, encouraging employee participation and involvement in problem solving.[59,75]

In healthcare, professionals and managers experiment with lean tools to improve efficiency, clinical outcomes, satisfaction, and safety for both employees and patients.[14] Hence, the hypotheses of this study are that the lean tools visual follow-up boards (H1), standardised work (H2), 5S (H3), and VSM (H4) promote employee and manager working conditions (outcomes: engagement in development, job satisfaction and exhaustion) in healthcare organisations that have implemented lean. The lean context (i.e., job resources and job demands) and the implementation process are considered important for the impact of lean tools on engagement in development, job satisfaction and exhaustion, and why the lean context and aspects of the implementation process (see Section 3.3) are controlled for. Moreover, since there are differences in responsibilities for development work between employees and managers, another proposition is that there are differences between employees and managers with regard to effects on engagement in development, job satisfaction and exhaustion, and why managers are controlled for.

For a summary of the aforementioned hypotheses and consequent analysis model, see Figure 1 and Table 1.

3. METHODS

Five organisations working with lean in the public sector in Sweden agreed to be included in the study: two university hospitals and three municipalities.
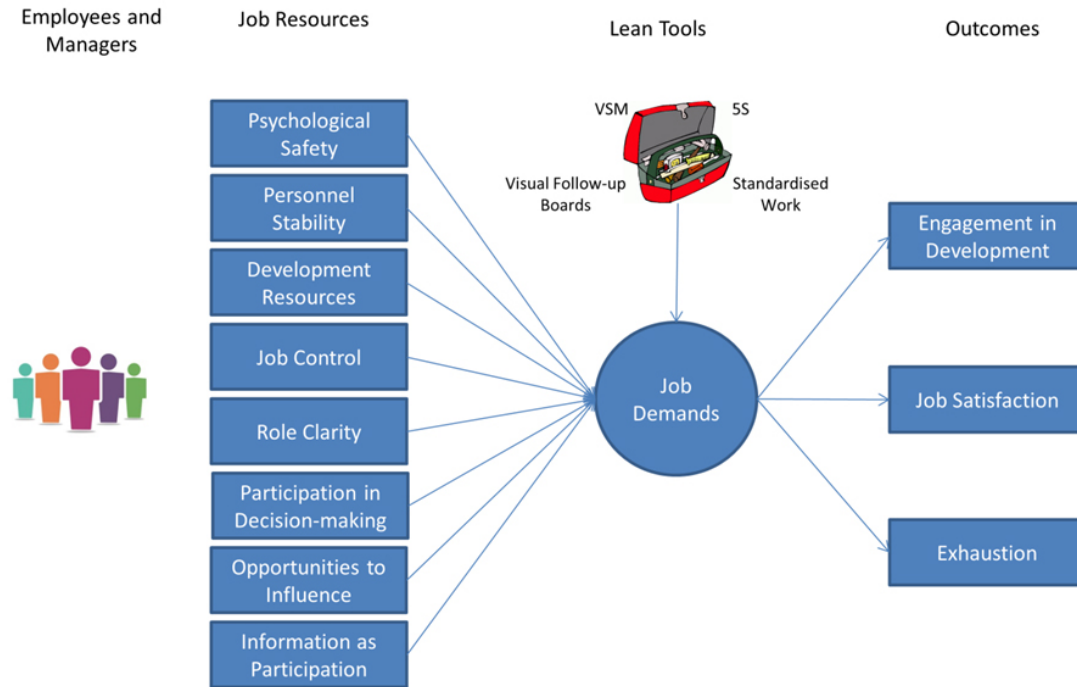
Figure 1. Illustration of hypotheses and analysis model

Table 1. Hypotheses and predictor variables in analysis model

Predictor variables	Hypothesis
Control variables	
• Age	
• Gender	
• Educational Level	
• Hospital	
• Manager	
Job Resources	
• Psychological Safety	
• Personnel Stability	
• Development Resources	
• Job Control	
• Role Clarity	
• Participation in Decision-making	
• Opportunities to Influence	
• Information as Participation	
Job Demands	
Lean Tools	
• Visual Follow-up Boards	H1
• Standardised Work	H2
• 5S (Housekeeping)	H3
• Value Stream Mapping (VSM)	H4

3.1 Questionnaire

A web-based questionnaire was sent out by email to employees and managers. A contact person within administration in each setting provided email addresses. The questionnaire was emailed in 2011 (baseline, T1) and in 2013 (follow-up, T2). Three reminders were subsequently emailed on both occasions. A total of 1,381 respondents in T1 (a response rate of 65%) and 1,139 respondents in T2 (a response rate of 51%) answered the questionnaire. A total of 894 respondents answered both T1 and T2.

3.2 Participants and organisations

The included organisations were selected based on variations with regard to operations, experiences of lean and geographical spread, and that top management had a clear vision of lean and explicitly stated that they work in a lean-inspired manner. Hospitals (units working with psychiatric healthcare, surgery, emergency healthcare, medicine healthcare, oncology, and diagnostics), and municipalities (units in elderly and social healthcare, including education and environmental administration) were represented in the study. This article presents results as a part of the overall study, namely the results from healthcare organisations that explicitly stated that they work in a lean-inspired manner in T1 (n = 448, including 56 managers): two hospitals and one municipality (elderly and social healthcare). The majority of the respondents were women (86.2%) and a total of 59.6% had a university degree.

3.3 Implementation process

Qualitative data, based on semi-structured interviews and focus group interviews between 2011 and 2012, analysed and presented in previous papers,[53, 78, 79] including the or-

ganisations in this study, gave information about certain aspects of the implementation processes. The implementation processes in all three organisations were characterised by a top-down strategy, where all managers and employees were educated in lean, most often by an internal lean support function and sometimes assisted by external consultants. The operative first-line managers were later responsible for implementing lean. Hospital 1 started to implement lean earlier (2006) compared to the municipality (2009) and hospital 2 (2009).

Table 2. Lean implementation process in organisations

	Municipality	**Hospital 1**	**Hospital 2**
Ownership strategic level	Moderate: close follow-ups by county politicians (Socialnämnden), but steering from senior management is perceived as unclear	Weak to Moderate: ownership from county politicians is weak	Weak: ownership from county politicians is weak, Hospital Director replaced, and Lean Support Function dissolved
Ownership operative level	Strong to moderate: value stream mapping (VSM) mandatory	Moderate: difficult to engage physicians in the implementation of lean	Moderate: unclear goals and difficult to engage physicians in the implementation of lean
Added job resources for implementing lean	Yes, from Socialnämnden	No	No

As shown in Table 2, the most apparent differences in the implementation process among the included organisations concerned the hospitals (1 and 2) versus the municipality: weak to moderate lean ownership[80, 81] at both strategic and operative levels, and no added job resources for implementing lean at the hospitals. These differences in the implementation processes were accounted for by including an additional measure, that is a variable controlling for hospitals in the quantitative analysis.

3.4 Measures

All variables were subjectively rated in a questionnaire format, where the respondents were asked to rate how well the described statements fit the description of how they perceived their work environment on a Likert scale. The answers "Do not know", "Not applicable", "Do not want to answer", and "Something else" were all categorised as missing values. Age, gender, educational level, hospital, and manager were used as control variables.

The questionnaire mainly consisted of questions from two validated questionnaires: the New Working Life (Sw. "Det Nya Arbetslivet")[82] and Leadership/Organisation/Health/Production (LOHP)[59] (see Table 3). Researchers in the research group designed other supplementary questions. Before distribution, seven representatives from the Swedish public sector and academia answered the questionnaire and gave feedback about how they interpreted the questions and the response scales. Corrections were made accordingly in order to ascertain the questionnaire's face validity. By examining Cronbach's alpha, the reliability of the indices was tested prior to analysis, where the lowest score was 0.68 (see Table 3).

3.5 Data analysis

Simple and multiple linear regression models were used to test the hypotheses; the same predictors (in T1) were used in all models. Outcome variables in the different models for the longitudinal analysis included engagement in development, job satisfaction and exhaustion in T2. The design of the simple and multiple four-level random intercept regression models was inspired by the JD-R model.[47] All explanatory levels were measured at the individual level. The multiple linear regression model included the following hierarchical steps: (1) Control Variables; (2) Job Resources; (3) Job Demands; and (4) Lean Tools (see Table 1). The reason for using the hierarchical steps was to examine the amount of variance accounted for by each step and to examine mediating effects (cf. Lin's hierarchical analysis model analysing causes, consequences and mediating effects of burnout among hospital employees[83]).

For the purpose of comparability, all variables in the study sample (n = 448) were standardised with a mean of zero and a standard deviation of one. Missing items in a scale were not replaced, as the level of missing items was considered to be at an acceptable level for all predictor variables, in other words below 20%.[84] However, 5S was considered to have a high level of missing values (25% in T1), which was due to many respondents answering "Do not know" (19% in T1), indicating that not all respondents were familiar with this specific lean tool. The large number of missing values for engagement in development in T2 (2.5% in T1 and 31% in T2) is interpreted as a decrease in engagement in development over time. Even so, the level of missing values in these variables was deemed to be a limitation in the study's analysis. All tests were made two-sided at $p < .05$ if not specifically stated otherwise. All statistical analysis was conducted using SPSS 19 (IBM Corporation, USA).

Table 3. Variables: origin, scales, mean values, standard deviation (*SD*), and cronbach's alpha (indexes)

	Variables	Scale	Mean T1 (*SD*)	Mean T2 (*SD*)	Cronbach's alpha T1	Cronbach's alpha T2
	Control variables:					
1	• Age (High to Low Age)	56-point	24.4 (10.7)			
2	• Gender (Male to Female)	Two-point	1.9 (0.3)			
3	• Educational level (Low to High Level)	Seven-point	4.5 (1.7)			
4	• Hospital (0-1)	Two-point	0.8 (0.4)			
5	• Manager (0-1)	Two-point	0.1 (0.3)			
	Predictor variables:					
	(1) Psychological safety (Low Agreement - High Agreement):				0.86	
6	• At my work we care about each other.	NWL/Four-point	3.4 (0.7)			
7	• At my work we treat each other with respect.	NWL/Four-point	3.3 (0.7)			
8	• I feel safe and accepted at my work.	NWL/Four-point	3.5 (0.6)			
9	• At this unit people can present ideas without the fear of being called stupid.	LOHP/Five-point	3.7 (0.8)			
	(2) Personnel stability:				0.83	
10	• Has any downsizing occured? (No Extent-High Extent)	NWL/Five-point	3.9 (1.2)			
11	• How did you perceive this? (Worsening-Improvement)	SQ/Three-point	1.8 (0.7)			
	(3) Development resources (Do not Agree-Agree):				0.72	
12	• It's easy to get enough resources for the testing of new ideas.	LOHP/Five-point	2.6 (1.0)			
13	• I have time to think in new ways in my work.	LOHP/Five-point	3.1 (0.9)			
14	• We are able to test ideas that have an uncertain outcome.	LOHP/Five-point	3.0 (0.9)			
	(4) Job control (No, Never-Yes, Mostly):				0.80	
15	• Are you free to decide how your work is to be done?	NWL/Four-point	3.2 (0.8)			
16	• Are you free to decide what is to be done in your work?	NWL/Four-point	2.8 (0.9)			
17	• Are you free to decide when your work is to be done?	SQ/Four-point	2.7 (0.9)			
18	• Have you enough powers to make decisions in your work?	NWL/Four-point	3.2 (0.7)			
	(5) Role clarity (Do not Agree-Agree):				0.70	
19	• All roles and responsibilities are clearly defined in my unit.	NWL/Four-point	3.0 (0.6)			
20	• Each unit's roles and responsibilities are clearly defined in my work.	NWL/Four-point	3.1 (0.6)			
	(6) Participation in decision-making (No Extent-High Extent):				0.69	
21	• To what extent do you participate in decision making at the organiszational level?	NWL/Four-point	1.8 (0.8)			
22	• To what extent do you participate in decision making at your unit?	NWL/Four-point	2.5 (0.8)			
	(7) Opportunities to influence (Do not Agree-Agree):				0.84	
23	• At my unit everyone participates in discussions about the future.	NWL/Three-point	2.1 (0.6)			
24	• At my unit everyone has an impact.	NWL/Three-point	2.0 (0.6)			
	(8) Information as participation (Do not Agree-Agree):				0.73	
25	• At my unit we get the information needed to be able to participate.	NWL/Three-point	2.3 (0.6)			
26	• At my unit we get information well in advance of important decisions.	NWL/Three-point	1.9 (0.7)			
	(9) Job demands (No, Never-Yes, Mostly):				0.71	
27	• Does your work demand you work very fast?	NWL/Four-point	3.1 (0.6)			
28	• Does your work demand you work very hard?	NWL/Four-point	3.1 (0.7)			
29	• Does your work demand a too big of a work effort?	NWL/Four-point	3.0 (0.7)			
30	• Does your work demand you to put yourself in other people's shoes?	NWL/Four-point	3.6 (0.7)			
31	• Does your work put you in emotionally difficult situations?	NWL/Four-point	3.1 (0.7)			
32	• Do you, in your work, have responsibility of people's lives and personal safety?	NWL/Four-point	3.4 (0.9)			
	(10) Visual Follow-Up Boards (No Extent-High Extent):				0.88	
33	• We use a follow-up board.	LOHP/Four-point	2.8 (1.2)			
34	• We use a follow-up board in our improvement project.	LOHP/Four-point	2.8 (1.2)			
	(11) Standardised Work (No Extent-High Extent):					
35	• We work in a standardised manner.	LOHP/Four-point	2.7 (1.0)			
	(12) 5S (Housekeeping) (No Extent-High Extent):					
36	• We work according to 5S (housekeeping).	LOHP/Four-point	2.7 (1.0)			
	(13) Value Stream Mapping (VSM) (No Extent-High Extent):				0.75	
37	• I participate in VSM work.	LOHP/Four-point	1.9 (1.1)			
38	• I participate in the work aimed at shortening lead times.	LOHP/Four-point	2.1 (1.1)			

Table 3. (continued.)

	Variables	Scale	Mean T1 (*SD*)	Mean T2 (*SD*)	Cronbach's alpha T1	Cronbach's alpha T2
	Outcome variables:					
39	(14) I feel engaged in our work group's lean work (Do not Agree-Agree).	SQ/Four-point	3.0 (0.8)	2.9 (0.8)		
	(15) Job satisfaction (Very Dissatisfied – Very Satisfied):				0.68	0.76
40	• How satisfied are you, overall, with the work environment at your work?	SQ/Four-point	3.0 (0.7)	2.9 (0.7)		
41	• Are you generally satisfied with your work?	LOHP/Five-point	4.2 (0.7)	4.1 (0.8)		
	(16) Exhaustion (No, Never-Yes, Mostly):				0.86	0.89
	How have you felt the last three months:					
42	• I have days when I feel wound up all the time.	NWL/Four-point	2.0 (0.7)	2.0 (0.8)		
43	• I have days when I feel a lot of pressure, on the verge of what I can manage.	NWL/Four-point	1.8 (0.7)	1.8 (0.8)		
44	• I have difficulties relaxing in my spare time.	NWL/Four-point	1.6 (0.7)	1.7 (0.8)		
45	• I am often tense.	NWL/Four-point	1.8 (0.8)	1.9 (0.8)		
46	• I often have worrying thoughts.	NWL/Four-point	1.7 (0.8)	1.7 (0.8)		
47	• I am often restless.	NWL/Four-point	1.5 (0.7)	1.6 (0.8)		
48	• I do not feel rested after I have taken it easy for a couple of days.	NWL/Four-point	1.8 (0.9)	2.0 (1.0)		
	NWL (New Working Life Questionnaire)					
	LOHP (Leadership/Organisation/Health/Production Questionnaire)					
	SQ (Supplementary Questions)					

A paired samples *T*-test was conducted for the three outcome variables (not standardised variables) comparing T1 and T2 in order to account for outcome variable development over time. As a means of analysing risks of multicollinearity, a Pearson correlation test (see Table 6) and a multi-collinearity test were used. None of the tolerance values were found to be below 0.2 (i.e., no multi-collinearity problems). Similarly, there were no correlations between the predictor variables higher than 0.54 (see Table 6). Also, descriptive statistics (see Table 4) were used.

4. RESULTS AND ANALYSIS

4.1 Descriptive statistics

As shown in Table 4, the majority of the respondents had worked in a lean-inspired manner for one to three years (60%), where visual follow-up boards, 5S and standardised work were used to a higher extent than VSM in T1.

Table 4. Descriptive statistics for included organisations (T1)

Descriptives T1:						Time group worked in a lean-inspired manner in T1:				Lean Tools			
Organisation	N	Mean age (*SD*)	Women (%)	University education (%)	Secondary education (%)	Less than one year (%)	1-3 years (%)	More than three years (%)	Misssing (%)	Visual Follow-up Boards: Mean (*SD*)	Standardised Work: Mean (*SD*)	5S: Mean (*SD*)	VSM: Mean (*SD*)
Hospital 1: surgery, emergency care, medicine care, oncology, and diagnostics	190	44.6 (11.6)	89.5	66.8	27.9	6.3	64.7	27.4	1.6	3.35 (0.76)	2.90 (0.92)	3.03 (0.95)	1.99 (1.00)
Hospital 2: psychiatric care and surgery	169	50.8 (9.4)	78.7	61.5	33.1	36.1	53.8	8.9	1.2	2.56 (1.16)	2.62 (0.93)	2.37 (0.98)	1.92 (0.92)
Municipality: eldercare and social care	89	47.7 (9.6)	93.3	40.4	46.1	37.1	61.8	1.1	0.0	1.91 (0.95)	2.44 (1.01)	2.30 (1.10)	2.10 (1.13)
Total	448	47.6 (10.7)	86.2	59.6	33.5	23.7	60.0	15.2	1.1	2.79 (1.10)	2.72 (0.96)	2.66 (1.04)	1.98 (1.00)

As shown in Table 5, both engagement in development and job satisfaction significantly decreased in the sample, between T1 and T2, and the level of exhaustion significantly increased (weakly). The decrease in job satisfaction and increase in exhaustion were more noticeable in hospital 1. In hospital 2 and the municipality, the decrease in job satisfaction was non-significant, while the municipality showed in-

dications of increased levels of exhaustion (non-significant).

According to the Pearson correlation test the managers showed a significantly higher level of engagement in development and job satisfaction compared to the employees, as shown in column 5 in Table 6. Due to the outcomes signalling a worsening of the respondents' working conditions,

a post-hoc analysis was conducted to analyse if any changes in the job resources and job demands had an effect on this worsening development. The analysis revealed a significant decrease in all job resources and for the level of job demands.

The employees, as opposed to the managers, experienced a significant increase in participation in decision-making and no significant difference in opportunities to influence.

Table 5. Paired samples *T*-test for included organisations

Organisation	N	Engagement in Development			Job Satisfaction			Exhaustion		
		T1 (*SD*)	T2-T1 (*SD*)	Sign.	T1 (*SD*)	T2-T1 (*SD*)	Sign.	T1 (*SD*)	T2-T1 (*SD*)	Sign.
Hospital 1: surgery, emergency care, medical care, oncology, and diagnostics	190	3.00 (0.81)	-0.16 (0.86)	.03	3.63 (0.63)	-0.23 (0.67)	.00	1.77 (0.59)	0.12 (0.56)	.01
Hospital 2: psychiatric care and surgery	169	2.95 (0.70)	-0.21 (0.74)	.00	3.61 (0.55)	-0.09 (0.58)	.06	1.71 (0.54)	-0.04 (0.46)	.33
Municipality: elderly and social care	89	3.20 (0.70)	-0.27 (0.62)	.00	3.61 (0.62)	-0.08 (0.65)	.29	1.79 (0.55)	0.11 (0.54)	.08
Total	448	3.01 (0.75)	-0.20 (0.77)	.00	3.62 (0.60)	-0.15 0(.64)	.00	1.75 (0.56)	0.06 (0.52)	.04

Table 6. Pearson correlation test for included independent and dependent variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Age	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Gender	.04	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Educational Level	.20**	- .09	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. Hospital	.01	- .13**	.21**	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Manager	- .11*	- .05	.22**	- .02	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. Psychological Safety	.03	- .06	.20**	.10*	.13**	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7. Personnel Stability	- .08	- .01	.02	- .15**	.09	.20**	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8. Resources	- .03	- .11*	- .14**	- .03	.08	.29**	.10*	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
9. Job Control	- .17**	- .05	.10*	.01	.21**	.31**	.00	.23**	1.00	-	-	-	-	-	-	-	-	-	-	-	-
10. Role Clarity	- .13**	- .01	.02	- .04	.10*	.43**	.21**	.21**	.13**	1.00	-	-	-	-	-	-	-	-	-	-	-
11. Participation in Decision-making	- .09	- .18**	.12*	- .03	.47**	.34**	.17**	.25**	.39**	.24**	1.00	-	-	-	-	-	-	-	-	-	-
12. Opportunites to Influence	- .01	- .03	.02	.07	.13**	.51**	.09	.33**	.24**	.40**	.30**	1.00	-	-	-	-	-	-	-	-	-
13. Information as Participation	.04	.01	-.06	- .07	.04	.38**	.16**	.36**	.12*	.39**	.27**	.54**	1.00	-	-	-	-	-	-	-	-
14. Job Demands	.17**	.03	.16**	- .05	.06	- .14**	- .18**	- .23**	- .06	- .11*	- .01	- .15**	- .06	1.00	-	-	-	-	-	-	-
15. Visual Follow-up Boards	.13**	- .07	.08	.38**	- .04	.14**	- .16**	.11*	- .07	.09	- .01	.10*	.07	.04	1.00	-	-	-	-	-	-
16. Standardised Work	.06	.07	.13*	.13*	.12*	.23**	.04	.07	.01	.24**	.06	.15**	.14**	.04	.26**	1.00	-	-	-	-	-
17. 5S (Housekeeping)	.01	.09	- .08	.16**	.01	.18**	- .08	.05	.02	.19**	-.05	.16**	.15**	- .07	.33**	.45**	1.00	-	-	-	-
18. Value Stream Mapping (VSM)	.01	.02	.15**	- .05	.37**	.21**	.10	.12*	.18**	.07	.25**	.14**	.04	.02	.19**	.37**	.11	1.00	-	-	-
19. Engagement in Development	- .03	.06	.01	- .08	.18**	.10	.15*	.22**	.13*	.12*	.20**	.13*	.14**	- .03	.09	.20**	.08	.38**	1.00	-	-
20. Job Satisfaction	- .17**	.00	.02	- .05	.17**	.32**	.33**	.30**	.20**	.31**	.21**	.28**	.26**	- .23**	- .08	.11*	.06	.17**	.43**	1.00	-
21. Exhaustion	.26**	.07	.01	- .08	- .09	- .22**	- .16**	- .28**	- .12*	- .07	- .13*	- .23**	- .20**	.33**	.07	.07	.02	.01	- .12*	- .47**	1.00

* p < .05; ** p < .01

4.2 Influence of lean tools

The managers significantly used the lean tools standardised work and VSM to a higher extent than the employees in T1 and why another post-hoc analysis, excluding managers, was conducted, analysing if the lean tools used had an effect on the worsening development of working conditions. The use of 5S and VSM was unchanged, the use of standardised work had increased (non-significantly; mean diff. = 0.13, *p* = .08), and the use of visual follow-up boards had significantly decreased among the employees (mean diff. = -0.23, *p* < .01).

With regard to engagement in development, the addition of lean tools in the multiple linear regression model increased the explained variance of the model by 13% (Diff. $R^2 = 0.13$, steps 3-4 in Table 7), while for job satisfaction it increased by 5% (Diff. $R^2 = 0.05$, steps 3-4 in Table 8) and for exhaustion by 0% (Diff. $R^2 = 0.00$, steps 3-4 in Table 9).

Standardised work and VSM significantly promoted engagement in development, both before and after having run the control variables of age, gender, educational level, hospital, manager, and the lean context of job resources and job demands (see Simple and step 4 in Table 7), while visual

follow-up boards and 5S did not affect engagement in development. Also, the addition of lean tools (i.e., standardised work and VSM) partly mediated that female respondents were overrepresented in engaging in development (see steps 3-4 in Table 7).

Table 7. Simple and multiple linear regression analysis for engagement in development

Predictor variables	Engagement in development				
	Simple	Step 1, $R^2 = 0.11$	Step 2, $R^2 = 0.23$	Step 3, $R^2 = 0.24$	Step 4, $R^2 = 0.37$
	$\beta\ (R^2)$	β	β	β	β
Age	-0.03 (0.00)	-0.12	-0.15[*]	-0.16[*]	-0.15[*]
Gender	0.06 (0.00)	0.14[*]	0.23[***]	0.23[***]	0.18[**]
Educational Level	0.01 (0.00)	-0.07	0.05	0.05	0.06
Hospital	-0.20 (0.01)	-0.31	-0.27	-0.27	-0.27
Manager	0.50[***] (0.03)	0.46[**]	0.22	0.22	-0.08
Psychological Safety	0.12[*] (0.01)		-0.17	-0.17	-0.26[**]
Personnel Stability	0.16[**] (0.02)		-0.05	-0.04	-0.04
Development Resources	0.26[***] (0.05)		0.47[***]	0.48[***]	0.47[***]
Job Control	0.15[**] (0.02)		-0.08	-0.09	-0.07
Role Clarity	0.14[**] (0.02)		0.09	0.10	0.07
Participation in Decision-making	0.23[***] (0.04)		0.18[*]	0.18	0.18[*]
Opportunities to Influence	0.15[**] (0.02)		-0.14	-0.14	-0.16
Information as Participation	0.15[**] (0.02)		0.04	0.02	0.04
Job Demands	-0.04 (0.00)			0.08	0.00
Visual Follow-up Boards	0.10 (0.01)				-0.05
Standardised Work	0.21[***] (0.04)				0.17[**]
5S (Housekeeping)	0.09 (0.01)				0.06
Value Stream Mapping (VSM)	0.41[***] (0.15)				0.32[***]

[*] $p \le .10$; [**] $p < .05$; [***] $p < .01$

Table 8. Simple and multiple linear regression analysis for job satisfaction

Predictor variables	Job satisfaction				
	Simple	Step 1, $R^2 = 0.08$	Step 2, $R^2 = 0.26$	Step 3, $R^2 = 0.28$	Step 4, $R^2 = 0.33$
	$\beta\ (R^2)$	β	β	β	β
Age	-0.15[***] (0.03)	-0.19[***]	-0.14[**]	-0.12[*]	-0.12[**]
Gender	-0.00 (0.00)	0.06	0.06	0.07	0.06
Educational Level	0.02 (0.00)	0.00	-0.01	0.00	0.01
Hospital	-0.12 (0.00)	-0.22	-0.12	-0.12	-0.14
Manager	0.45[***] (0.03)	0.14	0.07	.08	0.00
Psychological Safety	0.35[***] (0.10)		0.19[**]	0.18[*]	0.15
Personnel Stability	0.32[***] (0.11)		0.18[***]	0.17[**]	0.16[**]
Development Resources	0.34[***] (0.09)		0.19[**]	0.15[*]	0.16[*]
Job Control	0.23[***] (0.04)		0.05	0.07	0.08
Role Clarity	0.31[***] (0.09)		0.12	0.11	0.08
Participation in Decision-making	0.22[***] (0.05)		-0.05	-0.04	-0.02
Opportunities to Influence	0.27[***] (0.08)		0.01	0.00	-0.04
Information as Participation	0.26[***] (0.07)		0.01	0.04	0.04
Job Demands	-0.32[***] (0.05)			-0.20[**]	-0.20[**]
Visual Follow-up Boards	-0.07 (0.01)				-0.11
Standardised Work	0.10[**] (0.01)				0.13[**]
5S (Housekeeping)	0.06 (0.00)				0.13[**]
Value Stream Mapping (VSM)	0.17[***] (0.03)				0.02

[*] $p \le .10$; [**] $p < .05$; [***] $p < .01$

Standardised work and 5S significantly promoted job satisfaction, and there were indications that these lean tools mediated the effect of psychological safety, after having run the control variables and the lean context (see steps 3-4 in Table 8). VSM only significantly influenced job satisfaction in the simple linear regression model but not after having run

the control variables and the lean context (see Simple and step 4 in Table 8). There were also indications that visual follow-up boards had an inhibiting effect on job satisfaction (β= -0.11, p = .12).

None of the lean tools influenced employee and manager exhaustion (see Simple and step 4 in Table 9). Hence, only one hypothesis (H2: standardised work) could be fully confirmed.

Table 9. Simple and multiple linear regression analysis for exhaustion

Predictor variables	Exhaustion				
	Simple	Step 1, R^2 = 0.08	Step 2, R^2 = 0.18	Step 3, R^2 = 0.21	Step 4, R^2 = 0.21
	β (R^2)	β	β	β	β
Age	0.20*** (0.07)	0.21***	0.22***	0.20***	0.20***
Gender	0.05 (0.00)	0.03	0.00	-0.01	-0.01
Educational Level	0.01 (0.00)	-0.02	-0.06	-0.07	-0.07
Hospital	-0.15 (0.01)	-0.01	0.00	0.00	-0.04
Manager	-0.20* (0.01)	-0.01	0.04	0.02	0.02
Psychological Safety	-0.21*** (0.05)		-0.09	-0.07	-0.08
Personnel Stability	-0.13*** (0.03)		-0.06	-0.04	-0.04
Development Resources	-0.28*** (0.08)		-0.24**	-0.20**	-0.20**
Job Control	-0.11** (0.01)		0.07	0.04	0.05
Role Clarity	-0.07 (0.01)		0.05	0.06	0.05
Participation in Decision-making	-0.11** (0.02)		0.00	-0.01	-0.01
Opportunities to Influence	-0.19*** (0.05)		-0.01	0.00	0.00
Information as Participation	-0.17*** (0.04)		-0.03	-0.05	-0.06
Job Demands	0.40*** (0.11)			0.23**	0.21**
Visual Follow-up Boards	0.06 (0.01)				0.04
Standardised Work	0.05 (0.00)				0.04
5S (Housekeeping)	0.01 (0.00)				-0.02
Value Stream Mapping (VSM)	0.01 (0.00)				-0.01

* $p \leq .10$; ** $p < .05$; *** $p < .01$

4.3 Influence of lean context

With regard to engagement in development, the addition of job resources in the multiple linear regression model increased the explained variance of the model by 12% (Diff. R^2 = 0.12, steps 1-2 in Table 7), while for job satisfaction it increased by 18% (Diff. R^2 = 0.18, steps 1-2 in Table 8); and for exhaustion by 10% (Diff. R^2 = 0.10, steps 1-2 in Table 9).

Development resources, such as having time, significantly promoted engagement in development, both before and after having run the control variables (see Simple and step 2 in Table 7), and participation in decision-making tended to promote engagement in development (non-significant; $p \leq .10$) (see step 4 in Table 7). After having run the control variables and the lean context, respondents experiencing a low level of psychological safety were significantly more engaged in development compared to other respondents. Furthermore, older respondents, as compared to younger, indicated being more engaged in development (non-significant; $p \leq .10$).

Development resources tended to promote job satisfaction (non-significant; $p \leq .10$). Personnel stability and low levels

of job demands had a significant influence upon job satisfaction. Older respondents, as compared to younger, were more satisfied with their work.

Low levels of development resources and high levels of job demands significantly influenced exhaustion, both before and after having run the control variables and the lean context (see Simple and step 4 in Table 9). Younger respondents, as compared to older, were more exhausted.

Hence, H1 was not confirmed and H2 was confirmed, while H3 and H4 were only partly confirmed.

5. DISCUSSION

From the perspective that previous research on lean and working conditions in healthcare are scarce and contradictory,[18, 19] and consequently conclusions on lean's sustainability are lacking,[14] the aim of this article is to identify to what extent lean tools (visual follow-up boards, standardised work, 5S, and VSM) promote employees and managers' working conditions in healthcare organisations (outcomes: engagement in development, job satisfaction, and exhaustion). In the analysis, the lean context of job resources and

job demands, and aspects of the lean implementation process, were controlled for, all inspired by the JD-R model.[47]

In this study of healthcare employees and managers having implemented lean only one of the hypotheses was fully confirmed: the lean tool standardised work promoted the respondents' working conditions of engagement in development and job satisfaction but did not promote exhaustion. However, the results also revealed a deterioration of the respondents' working conditions over time, as the levels of engagement in development and job satisfaction decreased and the level of exhaustion increased.

With regard to the lean context, the results revealed that all job resources, except for employee participation in decision-making, had significantly decreased (non-significantly for employees' opportunity to influence) over time. Also, the results outlined that the respondents' job demands had decreased but that working conditions were dependent on job resources, especially development resources, as having time for development. The identified deterioration of the working conditions supports earlier research on the correlation between job demands, not supported by adequate job resources, affecting employee well-being.[47] Lean tools are claimed to improve the ability of individuals to participate and act.[59] In this study, participation in decision-making promoted engagement in development (cf. Vink et al.[85] and Winkel et al.[66]), but development resources were more influential. Moreover, personnel stability promoted the respondents' job satisfaction. Previous research stresses that work environment risks deteriorate if lean is implemented parallel to rationalisation processes,[24] which our results support: working conditions deteriorated in a context of job resources not balanced against the job demands. These results also manifest the strenuous situation healthcare organisations are subjected to.[1,3]

However, the purpose of lean in healthcare is to improve the healthcare processes[67,68] through the use of lean tools. The results of this study indicated that employees experiencing low levels of psychological safety engaged and participated in development through the use of the lean tools standardised work and VSM. Also, the respondents' participation in decision-making significantly increased over time. These results, and those that show that older employees were more engaged in development, may confirm that lean can be a means to finally resolve age-old frustrations with prior work systems.[26] Moreover, standardised work and 5S, closely related to standardisation, positively affected job satisfaction. Research has previously shown that a high degree of lean at the operative level may contribute to improved working conditions.[28] Even if none of the lean tools affected exhaustion, there were indications that the respondents' job satisfaction

was negatively affected by visual follow-up boards due to insufficient job resources. These results could be explained by the practice of individuals gathering in front of follow-up boards,[73] which might contribute to a more exposed role for both employees and managers if not supported by other job resources. This reasoning could be why the use of visual follow-up boards decreased over time. Our results point to the idea that VSM is most likely the most effective lean tool to promote participation and engagement in development work, and may also, if supported by other job resources, promote well-being. The character of the lean tool VSM can, according to the authors, be compared to a Rapid Improvement Event (RIE),[86] wherein employees are free of any other responsibilities and focus on a key area or process, emphasising teamwork and work process improvements,[87] and why such events will likely generate engagement in development. However, in this study, the healthcare managers were overrepresented in using VSM; the use of VSM was kept at a relatively low level at both T1 and T2, as well as in engagement in development and job satisfaction. Previous research demonstrates that operative healthcare managers are key actors in implementing development work, such as lean, as they have a major role in coaching employees to participate in the development work.[53,60,61] Our results indicate that VSM may also promote employee job satisfaction if VSM is not considered as an activity more suitable for management.

In all three organisations the lean implementation processes were characterised by a top-down strategy, which may often be regarded with mistrust by healthcare professionals.[43] In hospital 1, where 27% of the respondents had worked in a lean-inspired manner for more than three years, the implementation process was characterised by a weak to moderate lean ownership[80,81] with no added job resources. In hospital 1, the negative effects on the employees' working conditions were most evident. Other research has pointed out a possible dip in engagement of lean among employees after one to three years,[88] and in a UK public sector hospital lean even became a fad after three years.[26] In the municipality, where 37% had worked in a lean-inspired manner for less than one year, the implementation process was adversely characterised by strong to moderate lean ownership from county politicians and at an operative level.[80,81] However, in the municipality, as well as for hospital 2, which had started to implement lean three years after hospital 1, the respondents' engagement in development had decreased. The municipality also showed signs of increased exhaustion. Other research has outlined that if the lean implementation process deteriorates over time, such as a weakening of ownership, this may result in negative consequences on the psychosocial work environment in

healthcare,[18] which may have affected the outcomes seen in hospital 1.

In summary, our results imply that the lean implementations were not sustainable[38,39] due to a lack of job resources in combination with a weak lean implementation process, and why lean implementation risks becoming a fad in these organisations. In light of the last couple of decades rationalisation focus on the healthcare sector,[1–4] our results imply that it is especially important to focus on how we can create favourable working conditions by investing in development resources that enable employee engagement and long-term sustainability in healthcare.[83,89] Lean tools may remedy a poor implementation process and a poor lean context; our results indicate that VSM and standardised work may be such enabling lean tools but only to a limited extent.

Method discussion
This study contributes to knowledge about factors affecting the working conditions under the implementation of lean in the healthcare sector. One must consider that the chosen variables have only covered some job resources (i.e., part of the lean context) that influence engagement in development, job satisfaction and exhaustion.

The dependent variable job satisfaction is an index including items with different response scales (4 and 5), which may have affected the paired samples *T*-test analysing development over time. A dichotomisation of these items was considered but was deemed as presenting a too simplistic picture of reality. Moreover, the level of missing values for engagement in development is high, which is considered to be in line with our conclusions, namely that there is a decrease over time in engagement in development for both employees and managers.

The information about the lean implementation process is not complete but constitutes the available information. Also, studying the influence of lean tools in organisations that show a decline in working conditions may be cumbersome. However, analysing which job resources and lean tools influence engagement in development and employee well-being, in order to improve the knowledge of sustainable implementations of lean, may also be especially interesting in such a context.[66]

6. CONCLUSIONS

In the healthcare organisations that implemented lean, the lean tools VSM, standardised work and 5S promoted employees and managers' working conditions (engagement in development and/or job satisfaction, while not exhaustion) when supported by a supportive lean context, including job resources. When not supported by job resources, visual follow-up boards were inhibiting employee and manager job satisfaction.

In the unfavourable lean context in this study (i.e., job resources not balancing the job demands), the lean implementations could not be considered sustainable. Based on the results of this study, standardised work and VSM were considered central lean tools for employee and manager engagement in development and their job satisfaction, if also supported by other job resources.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare they have no conflicts of interest.

REFERENCES

[1] Dahlgaard JJ, Pettersen J, Dahlgaard-Park SM. Quality and lean health care: a system for assessing and improving the health of healthcare organisations. Total Quality Management & Business Excellence. 2011; 22(6): 673-689. http://dx.doi.org/10.1080/14783363.2011.580651

[2] Elg M, Witell L, Poksinska B, et al. Solicited diaries as a means of involving patients in development of healthcare services. International Journal of Quality and Service Sciences. 2011; 3(2): 128-145. http://dx.doi.org/10.1108/17566691111146050

[3] McKee M, Healy J. Hospitals in a changing Europe. Buckingham: Open University Press; 2002.

[4] Mohrman SA, Shani AB, McCracken A. Organizing for sustainable effectiveness. Organizing for sustainable health care: the emerging global challenge, 2nd ed. Bingley, West Yorkshire: Emerald Group Publishing Limited; 2012. 1-39 p.

[5] Bergin E, Rønnestad MH. Different timetables for change: understanding processes in reorganizations: a qualitative study in a psychiatric sector in Sweden. Journal of Health Organization and Management. 2005; 19(4/5): 355-377. http://dx.doi.org/10.1108/14777260510615396

[6] Federation of Swedish county councils. Swedish health care in the 1990s. Trends 1992-2000. Stockholm: Landstingsförbundet; 2002.

[7] Hood C. A public management for all seasons? Public Administration. 1991; 69(1): 3-19. http://dx.doi.org/10.1111/j.1467-9299.1991.tb00779.x

[8] Hood C. The "New Public Management" in the 1980s: variations on a theme. Accounting, Organizations and Society. 1995; 20(2): 93-109. http://dx.doi.org/10.1016/0361-3682(93)E0001-W

[9] Healy J, McKee M. Hospitals in a changing Europe. Improving Performance within the Hospital. Buckinham: Open University Press; 2002.

[10] Womack JP, Jones DT, Roos D. The machine that changed the world: the story of lean production. New York, NY: Rawson Associates; 1990.

[11] Liker JK. The Toyota way: 14 management principles from the world's greatest manufacturer: McGraw-Hill New York; 2004.

[12] Krafcik JF. Triumph of the lean production system. MIT Sloan Management Review. 1988; 30(1): 41.

[13] Brando de Souza L. Trends and approaches in lean healthcare. Leadership in Health Services. 2009; 22(2): 121-139. http://dx.doi.org/10.1108/17511870910953788

[14] D'Andreamatteo A, Ianni L, Lega F, et al. Lean in healthcare: a comprehensive review. Health Policy. 2015; 119(9): 1197-1209. http://dx.doi.org/10.1016/j.healthpol.2015.02.002

[15] Langstrand J. Exploring organizational translation: a case study of changes toward Lean Production [dissertation]. Linköping: Department of Management and Engineering; 2012.

[16] Shah R, Ward PT. Defining and developing measures of lean production. Journal of Operations Management. 2007; 25(4): 785-805. http://dx.doi.org/10.1016/j.jom.2007.01.019

[17] Womack JP, Jones D. Banish waste and create wealth in your corporation. New York: Free Press; 2003.

[18] Ulhassan W, von Thiele Schwarz U, Thor J, et al. Interactions between lean management and the psychosocial work environment in a hospital setting–a multi-method study. BMC health services research. 2014; 14(1): 1. http://dx.doi.org/10.1186/1472-6963-14-480

[19] Hasle P, Bojesen A, Langaa Jensen P, et al. Lean and the working environment: a review of the literature. International Journal of Operations & Production Management. 2012; 32(7): 829-849. http://dx.doi.org/10.1108/01443571211250103

[20] Landsbergis PA, Cahill J, Schnall P. The impact of lean production and related new systems of work organization on worker health. Journal of Occupational Health Psychology. 1999; 4(2): 108. http://dx.doi.org/10.1037/1076-8998.4.2.108

[21] Waring JJ, Bishop S. Lean healthcare: rhetoric, ritual and resistance. Social Science & Medicine. 2010; 71(7): 1332-1340. http://dx.doi.org/10.1016/j.socscimed.2010.06.028

[22] Losonci D, Demeter K, Jenei I. Factors influencing employee perceptions in lean transformations. International Journal of Production Economics. 2011; 131(1): 30-43. http://dx.doi.org/10.1016/j.ijpe.2010.12.022

[23] Delbridge R. The essentials of the new workplace-A guide to the human impact of modern working practices. Chichester: Wiley; 2005. Workers under lean manufacturing; 15-32.

[24] Westgaard R, Winkel J. Occupational musculoskeletal and mental health: significance of rationalization and opportunities to create sustainable production systems–a systematic review. Applied Ergonomics. 2011; 42(2): 261-296. http://dx.doi.org/10.1016/j.apergo.2010.07.002

[25] Hasle P. Lean production—An evaluation of the possibilities for an employee supportive lean practice. Human Factors and Ergonomics in Manufacturing & Service Industries. 2014; 24(1): 40-53. http://dx.doi.org/10.1002/hfm.20350

[26] McCann L, Hassard JS, Granter E, et al. Casting the lean spell: the promotion, dilution and erosion of lean management in the NHS. Human Relations. 2015; 68(10): 1557-1577. http://dx.doi.org/10.1177/0018726714561697

[27] Drotz E, Poksinska B. Lean in healthcare from employees' perspectives. Journal of Health Organization and Management. 2014; 28(2): 177-195. http://dx.doi.org/10.1108/JHOM-03-2013-0066

[28] Dellve L, Williamsson A, Strömgren M, et al. Lean implementation at different levels in Swedish hospitals: the importance for working conditions and stress. International Journal of Human Factors and Ergonomics. 2015; 3(3-4): 235-253. http://dx.doi.org/10.1504/IJHFE.2015.073001

[29] De Treville S, Antonakis J. Could lean production job design be intrinsically motivating? Contextual, configurational, and levels-of-analysis issues. Journal of Operations Management. 2006; 24(2): 99-123. http://dx.doi.org/10.1016/j.jom.2005.04.001

[30] Womack JP, Miller D. Going lean in health care: Institute for Healthcare Improvement Cambridge, MA; 2005.

[31] Niemeijer GC, Flikweert E, Trip A, et al. The usefulness of lean six sigma to the development of a clinical pathway for hip fractures. Journal of Evaluation in Clinical Practice. 2013; 19(5): 909-914. http://dx.doi.org/10.1111/j.1365-2753.2012.01875.x

[32] Cullinane SJ, Bosak J, Flood PC, et al. Job design under lean manufacturing and the quality of working life: a job demands and resources perspective. The International Journal of Human Resource Management. 2014; 25(21): 2996-3015. http://dx.doi.org/10.1080/09585192.2014.948899

[33] Emiliani M, Stec D. Leaders lost in transformation. Leadership & Organization Development Journal. 2005; 26(5): 370-387. http://dx.doi.org/10.1108/01437730510607862

[34] Koenigsaecker G. Leadership and the lean transformation. Manufacturing Engineering. 2005; 135(5): 7-12.

[35] Bhasin S, Burcher P. Lean viewed as a philosophy. Journal of Manufacturing Technology Management. 2006; 17(1): 56-72. http://dx.doi.org/10.1108/17410380610639506

[36] Beer M, Nohria N. Cracking the code of change. Harvard Business Review. 2000; 78(3): 133-141. PMid: 11183975.

[37] Bateman N. Sustainability: the elusive element of process improvement. International Journal of Operations & Production Management. 2005; 25(3): 261-276. http://dx.doi.org/10.1108/01443570510581862

[38] Elg M, Ellström P, Klofsten M, et al. Sustainable Development in Organizations. Studies on Innovative Practices. Northampton, Massachusetts: Edward Elgar Publishing Limited; 2015. Sustainable development in organizations. http://dx.doi.org/10.4337/9781784716899

[39] Brännmark M, Benn S. A Proposed Model for Evaluating the Sustainability of Continuous Change Programmes. Journal of Change Management. 2012; 12(2): 231-245. http://dx.doi.org/10.1080/14697017.2012.672449

[40] Brundtland Commission. Our common future: report of the world commission on environment and development. New York: United Nations; 1987.

[41] Axtell CM, Holman DJ, Unsworth KL, et al. Shopfloor innovation: facilitating the suggestion and implementation of ideas. Journal of Occupational and Organizational Psychology. 2000; 73(3): 265-285. http://dx.doi.org/10.1348/096317900167029

[42] Baer M. Putting creativity to work: the implementation of creative ideas in organizations. Academy of Management Journal. 2012; 55(5): 1102-1119. http://dx.doi.org/10.5465/amj.2009.0470

[43] Choi S, Holmberg I, Löwstedt J, et al. Executive management in radical change—The case of the Karolinska University Hospital merger. Scandinavian Journal of Management. 2011; 27(1): 11-23. http://dx.doi.org/10.1016/j.scaman.2010.08.002

[44] Trägårdh B, Lindberg K. Curing a meagre health care system by lean methods—translating 'chains of care' in the Swedish health care sector. The International Journal of Health Planning and Management. 2004; 19(4): 383-398. http://dx.doi.org/10.1002/hpm.767

[45] Karasek Jr RA. Job demands, job decision latitude, and mental strain: implications for job redesign. Administrative Science Quarterly. 1979: 285-308. http://dx.doi.org/10.2307/2392498

[46] Karasek R, Theorell T. Healthy work : stress, productivity, and the reconstruction of working life. New York, N.Y.: Basic Books; 1990.

[47] Demerouti E, Bakker AB, Nachreiner F, et al. The job demands-resources model of burnout. Journal of Applied Psychology. 2001; 86(3): 499. http://dx.doi.org/10.1037/0021-9010.86.3.499

[48] Niepce W, Molleman E. Work design issues in lean production from a sociotechnical systems perspective: Neo-Taylorism or the next step in sociotechnical design? Human Relations. 1998; 51(3): 259-287. http://dx.doi.org/10.1108/01443571211250103

[49] Lewig KA, Dollard MF. Emotional dissonance, emotional exhaustion and job satisfaction in call centre workers. European Journal of Work and Organizational Psychology. 2003; 12(4): 366-392. http://dx.doi.org/10.1080/13594320344000200

[50] Bakker AB, Demerouti E, Verbeke W. Using the job demands-resources model to predict burnout and performance. Human Resource Management. 2004; 43(1): 83-104. http://dx.doi.org/10.1002/hrm.20004

[51] Bakker AB, Demerouti E. The job demands-resources model: state of the art. Journal of Managerial Psychology. 2007; 22(3): 309-328. http://dx.doi.org/10.1108/02683940710733115

[52] Docherty P, Kira M, Shani AB. Creating sustainable work systems - developing social sustainability. New York, NY: Routledge; 2009. What the world needs now is sustainable work systems.

[53] Lindskog P, Vänje A, Törnkvist Å, et al. Sustainable Lean in psychiatry? Assessment through socio-technical principles. International Journal of Quality and Service Sciences. 2016; 8(1). http://dx.doi.org/10.1108/IJQSS-07-2015-0056

[54] Pedersen ERG, Huniche M. Determinants of lean success and failure in the Danish public sector: a negotiated order perspective. International Journal of Public Sector Management. 2011; 24(5): 403-420. http://dx.doi.org/10.1108/09513551111147141

[55] Ahgren B, Axelsson R. Determinants of integrated health care development: chains of care in Sweden. The International Journal of Health Planning and Management. 2007; 22(2): 145-157. http://dx.doi.org/10.1002/hpm.870

[56] Hallin K, Danielson E. Registered nurses' perceptions of their work and professional development. Journal of Advanced Nursing. 2008; 61(1): 62-70. http://dx.doi.org/10.1111/j.1365-2648.2007.04466.x

[57] Hallin K, Danielson E. Registered nurses' perceptions of their work and professional development. Journal of Advanced Nursing. 2008; 61(1): 62-70. http://dx.doi.org/10.1108/1366562091099 6151

[58] Lorden AL, Zhang Y, Lin SH, et al. Measure is of success: the role of human factors in lean implementation in healthcare. The Quality Management Journal. 2014; 21(3): 26.

[59] Fagerlind Ståhl AC, Gustavsson M, Karlsson N, et al. Lean production tools and decision latitude enable conditions for innovative learning in organizations: a multilevel analysis. Applied Ergonomics. 2015; 47: 285-291. http://dx.doi.org/10.1016/j.apergo.2014.10.013

[60] Dopson S, Fitzgerald L. The role of the middle manager in the implementation of evidence-based health care. Journal of Nursing Management. 2006; 14(1): 43-51. http://dx.doi.org/10.1111/j.1365-2934.2005.00612.x

[61] Andreasson J, Eriksson A, Dellve L. Health care managers' views on and approaches to implementing models for improving care processes. Journal of Nursing Management. 2015; 24(2): 219-227. http://dx.doi.org/10.1111/jonm.12303

[62] Börnfelt PO. Förändringskompetens på industrigolvet: kontinuerligt förändringsarbete i gränslandet mellan lean production och socioteknisk arbetsorganisation [Change competence on the shop floor: continuous change work in the borderland between lean production

[63] Oudhuis M, Olsson A. Japaner, japaner... Kulturens betydelse vid övergång till Toyotainspirerad lean produktion i ett japanskägt företag i Sverige [Japanese, Japanese people...The role of culture in the transitioning to lean production, inspired by Toyta, in a Japanese owned company in Sweden]. Arbetsmarknad & Arbetsliv. 2011; 17(2): 11-27.

[64] Vänje A, Brännmark M. Walking around the pyramids: managers' shop-floor activities in lean-inspired organizations. Economic and Industrial Democracy. 2015. http://dx.doi.org/10.1177/0143831X15580351

[65] Eklund J, Ellström PE, Karltun J. Proceedings of the first world congress on Ergonomics for global quality and productivity. Standardisation-A Means for Creating Developing Work? 1998; 165-168.

[66] Winkel J, Edwards K, Birgisdóttir BD, et al. Facilitating and inhibiting factors in change processes based on the lean tool 'value stream mapping': an exploratory case study at hospital wards. International Journal of Human Factors and Ergonomics. 2015; 3(3-4): 291-302. http://dx.doi.org/10.1504/IJHFE.2015.073000

[67] Poksinska B. The current state of lean implementation in health care: literature review. Quality Management in Healthcare. 2010; 19(4): 319-329. http://dx.doi.org/10.1097/QMH.0b013e3181fa07bb

[68] Radnor ZJ, Holweg M, Waring J. Lean in healthcare: the unfilled promise? Social Science & Medicine. 2012; 74(3): 364-371. http://dx.doi.org/10.1016/j.socscimed.2011.02.011

[69] Mazzocato P, Savage C, Brommels M, et al. Lean thinking in healthcare: a realist review of the literature. Quality and Safety in Health Care. 2010; 19(5): 376-382. http://dx.doi.org/10.1136/qshc.2009.037986

[70] Olivella J, Cuatrecasas L, Gavilan N. Work organisation practices for lean production. Journal of Manufacturing Technology Management. 2008; 19(7): 798-811. http://dx.doi.org/10.1108/17410380810898750

[71] Pettersen J. Defining lean production: some conceptual and practical issues. The TQM Journal. 2009; 21(2): 127-142. http://dx.doi.org/10.1108/17542730910938137

[72] Jaca C, Viles E, Jurburg D, et al. Do companies with greater deployment of participation systems use Visual Management more extensively? An exploratory study. International Journal of Production Research. 2014; 52(6): 1755-1770. http://dx.doi.org/10.1080/00207543.2013.848482

[73] Bititci U, Cocca P, Ates A. Impact of visual performance management systems on the performance management practices of organisations. International Journal of Production Research. 2015: 1-23. http://dx.doi.org/10.1080/00207543.2015.1005770

[74] Liker J, Meier D. The Toyota way field book: a practical guide for implementing Toyota's 4Ps. New York: McGraw-Hill; 2006.

[75] Fagerlind Ståhl AC. Live long and prosper: health-promoting conditions at work [dissertation]. [Linköping]: Department of Medical and Health Sciences; 2015.

[76] Jaca C, Viles E, Paipa-Galeano L, et al. Learning 5S principles from Japanese best practitioners: case studies of five manufacturing companies. International Journal of Production Research. 2014; 52(15): 4574-4586. http://dx.doi.org/10.1080/00207543.2013.878481

[77] Henrique DB, Rentes AF, Godinho Filho M, et al. A new value stream mapping approach for healthcare environments. Production Planning & Control. 2016; 27(1): 24-48. http://dx.doi.org/10.1080/09537287.2015.1051159

[78] Halvarsson Lundkvist A, Lindskog P, Ståhl J, et al. Conditions enabling development in national lean programmes (submitted). 2016.

[79] Eklund J, Halvarsson Lundkvist A, Lindskog P. Sustainable development in organizations: studies on innovative practices. Cheltenham, UK: Edward Elgar Publishing Limited; 2015. Lean implementation, work environment and sustainability; 29-41.

[80] Brulin G, Svensson L. Managing sustainable development programmes: a learning approach to change: Gower Publishing, Ltd.; 2012.

[81] Benn S, Dunphy D, Griffiths A. Organizational change for corporate sustainability: Routledge; 2014.

[82] Oxenstierna G, Widmark M, Finnholm K, et al. A new questionnaire and model for research into the impact of work and the work environment on employee health. Scandinavian Journal of Work, Environment & Health. 2008; 2008(6): 150-162.

[83] Lin YW. The causes, consequences, and mediating effects of job burnout among hospital employees in Taiwan. Journal of Hospital Administration. 2012; 2(1): 15. http://dx.doi.org/10.5430/j ha.v2n1p15

[84] Dong Y, Peng CYJ. Principled missing data methods for researchers. SpringerPlus. 2013; 2(1): 1-17. http://dx.doi.org/10.1177/0 018726714561697

[85] Vink P, Imada A, Zink K. Defining stakeholder involvement in participatory design processes. Applied Ergonomics. 2008; 39(4): 519-526. http://dx.doi.org/10.1016/j.apergo.2008.02.009

[86] McNichols T, Hassinger R, Bapst GW. Quick and continuous improvement through kaizen blitz. Hospital Materiel Management Quarterly. 1999; 20(4): 1-7.

[87] Radnor Z, Walley P. Learning to walk before we try to run: adapting lean for the public sector. Public Money and Management. 2008; 28(1): 13-20. http://dx.doi.org/10.1111/j.1467-9302.20 08.00613.x

[88] Eriksson A, Holden RJ, Williamsson A, et al. A case study of three Swedish hospitals' strategies for implementing lean production. Nordic Journal of Working Life Studies. 2016; 6(1): 105. http://dx.doi.org/10.19154/njwls.v6i1.4912

[89] Niemeijer GC, Flikweert E, Trip A, et al. The usefulness of lean six sigma to the development of a clinical pathway for hip fractures. Journal of Evaluation in Clinical Practice. 2013; 19(5): 909-914. http://dx.doi.org/10.1111/j.1471-6712.2012.00996.x