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Lean SPRInT: A management tool for initiating Lean in public hospitals in KwaZulu-Natal

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L NAIDOO
University of Kwa-Zulu-Natal
benzzn@gmail.com

Z FIELDS* (https://orcid.org/0000-0001-5353-1807)
University of Johannesburg
ziskaf@uj.ac.za
* corresponding author

ABSTRACT

South African public hospitals are beset with barriers to the realisation of strategic health outcomes owing to operational inefficiency. The Lean SPRInT aids managers with Lean implementation by assessing their hospitals' readiness status for Lean to improve operational efficiency.

An observational descriptive study employing quantitative methods was conducted across 73 public hospitals in KwaZulu-Natal (KZN). Simple random sampling was used to attain a minimum sample size of 218 senior managers who completed semi-structured questionnaires. Exploratory Factor Analysis was used to identify latent constructs. Confirmatory Factor Analysis was used to determine the reliability and validity of factors. Structural Equation Modelling assessed the acceptability of the model.

The participant response rate was 96.8% (n=211). Three Critical Success Factors (strategic leadership and organisational attitude; integration of Lean elements, tools and techniques; and basic stability in operational processes), from which the electronic Lean SPRInT was developed, were derived after several iterations of Exploratory Factor Analysis (EFA). All reliability and validity conditions have been met, thus rendering the model reliable and valid

Lean SPRInT is a management tool for assessing hospitals' readiness status for Lean. A six-step process for the deployment of Lean SPRInT is proposed. A phasic approach for Lean implementation, together with close monitoring using the HLA tool is recommended. Unified efforts and decentralised decision-making are more likely to lead to effective implementation.

Key phrases

Contemporary management tool; healthcare management; healthcare system; lean management and operational efficiency

1. INTRODUCTION

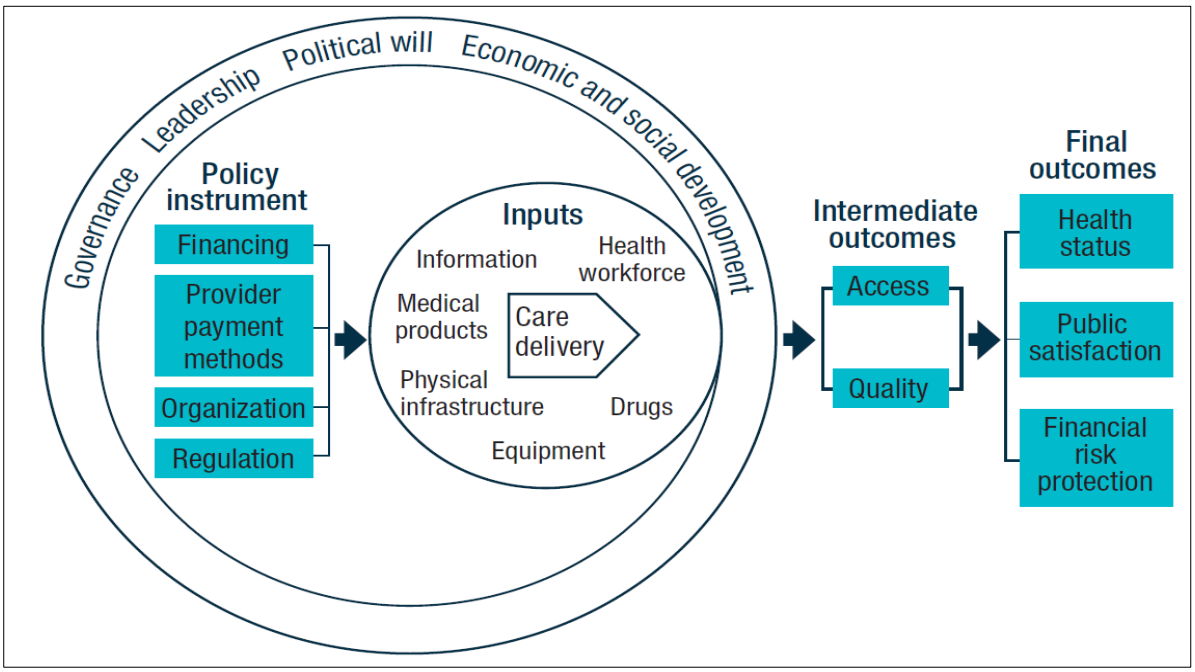
The ultimate goal of a healthcare system is to provide quality and affordable healthcare to society. A healthier nation would enjoy the benefit of financial risk protection and a satisfied population (Yip & Hafez 2015:5-6). Several resources inputs are impelled by policy instruments and form the recipe for quality of and access to healthcare which ultimately leads to the desired health benefit to society (Figure 1). Both healthcare quality and benefit is an important outcome of efficiency in the healthcare system that may lead to the achievement of improved access and quality with the least amount of resource inputs.

Lean thinking (or "Lean") is recognised as a systematic approach to improve efficiency by eliminating waste and pursuing perfection with minimal resources (Omogbai & Salonitis 2016:106; Røvik & Andersen 2015:1; Womack, Jones & Roos 2007:1). The primary focus of Lean is on reducing waste, synchronising flows and managing variability in (process) flows. A critical aspect of Lean is the empowerment of employees to make changes to their work, thereby improving processes from the floor upwards. On an organisational level, mapping the entire process allows management to augment process steps that are value-adding and relevant to the final product or service for the customer, while systematically eradicating those that fail to add value (Dickson, Singh, Cheung, Wyatt & Nugent 2009). Lean methodology is pinned on five tenets (Zidel 2006):

- **Specify value** by asking oneself what is valuable to the end-user (the patient);
- **Identify the value stream** using a Value Stream Map (VSM);
- **Make the value stream flow** by restructuring process steps and eliminating, non-value-adding steps (eliminating bottlenecks);
- **Pull**: The forerunning process down the value-stream signals when upstream activities can begin in order to stabilize demand on the system; and
- **Pursue perfection** through continuous improvement.

Wide scale adoption of such a management approach in healthcare facilities would contribute to the attainment of the aforementioned goal. See Figure 1 for a systems framework for operational efficiency in a healthcare system.

Figure 1: A systems framework for operational efficiency in a healthcare system



Source: Yip & Hafez (2015:6)

2. BACKGROUND

South African public healthcare facilities are beset with vastly apparent barriers to the realisation of strategic health outcomes. The framework depicted in Figure 2 provides a typical roadmap from organisational strategy to strategic outcomes, guided by organisational vision with strategic goals and often laden with barriers and enablers which widen or narrow the intervention-implementation gap, respectively. Failure to recognise and augment these enablers or "critical success factors" conjugately undermines their potential of narrowing the intervention-implementation chasm. This study is anchored on the development of a tool which assesses the status of the critical success factors which have the potential of narrowing the operational efficiency intervention-implementation gap.

Operational inefficiency derives from the sub-optimal processing of resource inputs in the healthcare system and leads to poor performance of the organisation in terms of measurable health care metrics and financial reports. Such inefficiency results from, *inter alia*, the mismatch between the genuine need (demand) for healthcare services and the supply thereof (over- and under-utilisation); expenditure on items such as drugs, sundries, blood products and laboratory services; inappropriate admissions and prolonged average lengths of stay; deviation from prescribed treatment protocols and medicine formularies; negative

incidents and clinical errors and hospital-acquired infections (Madubula, English, Padayachee & Mkhize 2014).

Lean can be viewed as both a catalyst for interventions in an organisation on a continuous improvement journey and as an intervention itself which, through its tools and techniques, maximises service and production output with minimal resource inputs by eliminating waste and "doing better with less" (Improta, Romano, Di Cicco, Ferraro, Borrelli, Verdoliva, Cesarelli 2018:1-2; Mayosi & Benatar 2014:1351; Omogbai & Salonitis 2016:106). The Lean Success Predictor for Rapid Initiation Tool (Lean 'SPRInT') is a tool for healthcare managers to embark on the Lean transformation journey by assessing their hospitals' status of CSFs for Lean initiation.

Lean SPRInT is characteristically different from scrum methodology in that scrum is described as a process framework under the umbrella of Agile with four specific events to optimise the work carried out by small teams: Sprint Planning, Daily Scrum, Sprint Review and Sprint Retrospective (Reddy 2016; Sutherland & Schwaber 2013:3). As indicated by Beck, Beedle, Bennekum, Cockburn, Cunningham, Fowler, Grenning, Highsmith, Hunt, Jeffries, Kern, Marick, Martin, Mellor, Schwaber, Sutherland & Thomas (2001), Agile is a philosophy documented in the Agile Manifesto and espouses specific values that contribute to flexible, change-adaptable and quick manufacturing of products. These values of Agile highlight the importance of team member interactions, collaborations and adaptability to change to produce products incrementally.

Scrum has been used since the early 1990s to manage complex product development such as software. The term "sprint", in terms of the scrum framework is defined as a time period or time-box, usually 2 to 4 weeks, within which a potentially releasable product increment is created (Sutherland & Schwaber 2013:3). A scrum sprint can be regarded as a project with a specific time frame that is not more than a month. Lean SPRInT is accordingly not in any way related to scrum sprint and should not be confused with the methodology used in Agile Lean. Lean SPRInT is an acronym for an assessment tool that can be used by managers to assess the state of readiness for Lean implementation in hospitals.

Lean SPRInT could be used as an innovative means for the rapid but systematic initiation of Lean as a novel operations management approach in public hospitals across KwaZulu-Natal. This could result in widespread adoption of the practice of Lean by healthcare managers both in the public and private sectors nationwide. Successful Lean rollout in turn

facilitates the narrowing of the intervention-implementation gap for the realisation of strategic goals. See Figure 2 for the Intervention-implementation gap in the organisational strategy roadmap.

Figure 2: Intervention-implementation gap in the organisational strategy roadmap

Source: Author developed

3. LITERATURE REVIEW

With the need for overhauling the health systems delivery platform in KwaZulu-Natal, the realisation of the strategic priorities in its health transformation agenda has become ever more exigent (KZN Department of Health 2018a, 2018b). Honing in on examples of operations or systems management priorities reflected in the KZN Department of Health's 2018-2019 Annual Performance Plan (Table 1), it is not unreasonable to deduce that a considerable portion of the KZN Department of Health priorities and goals are overtly in need of adroit managers with a sound management approach to be successfully addressed.

Table 1: Examples of KwaZulu-Natal Department of Health Operations or Systems Management-related Priorities 2018-2019

KZN Department of Health Priorities	Key focus areas and interventions (Operations or Systems Management-related items)
Effective budget management	• Ensure cost containment and efficiency measures are in place and strictly adhered to
Improve patient waiting times	• Phased implementation of Centralised Chronic Medicines Dispensing and Distribution
Improve audit outcomes	• Supply Chain, Asset & Contract Management Strategy • Internal control and rigorous implementation & monitoring of the Audit Improvement Plan • Performance Information Improvement Plan • Financial management including Cost Containment Plan • Implement & monitor reviewed decentralised SCM, Financial and Human Resource delegations
Improve HR management	• Strengthen performance management & development
Improve management of performance information	• Implement strategy to improve record management • Rollout of web-based District Health Information System • Improve review and use of data at facility, sub-district & district level and improve the feedback system • Implement performance information management strategy • Implement the approved IT strategy including increasing broadband access at facility level
Manage finalisation and implementation of the integrated Turn-Around Plan	• Finalise the integrated Turn-Around Plan and manage and monitor implementation at all levels • Establish enabling environment for service delivery
Improve access, inequities, quality and efficiencies of District Hospitals	• Finalise the District Hospital Efficiency Study and use findings to inform the District Hospital Rationalisation Plan • Rationalisation including: Review referral systems & pathways: Redefine roles of Family Physicians in District Health System; and Complexing of identified facilities to ensure optimal utilisation of resources • Scale up implementation of National Core standards • Strengthen Clinical Governance in all facilities

KZN Department of Health Priorities	Key focus areas and interventions (Operations or Systems Management-related items)
Implement strategy to reduce Medico-legal risks	• Finalise and implement the approved Medico-Legal Strategy & Implementation Plan
Reduce maternal mortality	• Improve safety at caesarean section delivery sites • Improve quality of antenatal, intrapartum and postnatal care
Reduce under 5 mortality	• Strengthen notification of deaths of children in hospitals • Improve clinical audits of deaths • Strengthen Paediatric outreach through the District Clinical Specialist Teams

Source: KZN Department of Health (2018a)

Against this backdrop, Lean is proposed as a contemporary approach to efficiently execute these systems management priorities. Research results show both successful and unsuccessful Lean implementation in various industries, indicating that CSFs for its initiation have to be recognised (Kundu 2012:302). There is scarce empirical literature to guide how Lean implementation is operationalized in healthcare (Burgess & Radnor 2013:220). There is limited evidence demonstrating the existence of tools for predicting at the outset the success of Lean initiation.

A seminal structure literature review of 177 research papers dating from 2000 to 2015 was conducted across several elements of health care operations management, including service quality, service operations strategy, service scheduling, service performance and frontline employees (Jha, Sahay & Charan 2016: 259-279). The literature review revealed that a large proportion of empirical studies have been conducted in developed nations (Jha *et al*. 2016: 271). This necessitates more healthcare operations management research in developing and underdeveloped countries due to the unique challenges experienced in these nations compared to the developed nations.

Evidence on the use of electronic tools for predicting the success of Lean initiation is lacking. It has been argued that existing Lean assessment tools provide qualitative analysis and do not provide any clear direction of where the improvement efforts should be directed (Srinivasaraghavan & Allada 2006:1159). In addition, there is limited research on tools that assist with Lean deployment strategy elements (Machado Guimarães & Crespo de Carvalho 2014:3-4). The assessment tools identified in reviewed literature do not offer any success predictor instrument for Lean implementation in hospitals.

4. ETHICS

Research ethics approval (HSS/0031/016D) was obtained from the Human Social Sciences Research Ethics Committee (HSSREC) at the University of KwaZulu-Natal (UKZN). Permission was also obtained from the KZN Department of Health's Provincial Health Research and Knowledge Management unit (KZ_2016RP31_475) and Deputy Director General for Specialised Services and Clinical Support. Informed consent was obtained from all participants. Permission was granted by Dr. Danie Vermaak for the use of his research questionnaire elements in the formulation of the data collection tool for this study.

5. METHODOLOGY

The primary aim of this observational descriptive study which employed quantitative methods was to develop a Lean Success Predictor for Rapid Initiation Tool (Lean SPRInT) for the initiation of Lean in public hospitals across KwaZulu-Natal, South Africa.

5.1 Study site and sampling

The research was conducted across 73 public hospitals from a target population of 500 senior managers within the province of KZN. Simple random sampling was used.

For exploratory factor analysis, experts argue that the n:p ratio should be at least 3 to 6 subjects (n) per test item (p), set traditionally to a ratio of 5 to 1 but can be up to 20 to 1 (Kyriazos 2018:2223; MacCallum, Widaman, Zhang & Hong 1999:84-85; Schumacker & Lomax 2015:240). A sample size of at least 192 (based on a subject: item ratio of 6:1) was required. The planned sample size of senior managers, considering a 5% margin of error and 95% confidence interval, was 218. In terms of the proposition by MacCallum *et al*. (1999:89) that the sample size can be judged acceptable if the communalities are high (squared multiple correlation > 0.6) and factors relatively few in number (3 factors in this study), the sample of 211 is reliable (MacCallum *et al*. 1999: 89).

5.2 Data collection and analysis

A self-administered, semi-structured questionnaire with mixed categorical, open-ended and variable Likert-scale questions was used for data collection. Cronbach's alpha was used to determine the internal consistency of the test items, looking particularly for homogeneity of items measuring latent constructs (Faith, Kim & Heo 2015:2) . Cronbach's alpha generally >0.7 was considered acceptable (Bujang, Omar & Baharum 2018:88-89; Taber 2018:1278, 1288). Cronbach's alpha for this study is reflected in Table 2. Data was reduced using EFA to identify latent constructs. Confirmatory Factor Analysis (CFA) was used to determine the reliability and validity (both convergent and discriminant) of these factors. Structural Equation

Modelling (SEM) fit indices were then applied to assess acceptability of the measurement model.

6. RESULTS

The participant response rate was 96.8% (*n*=211). The results of the Likert scale ratings were used to identify three CSFs after several iterations of EFA.

6.1 Validity and reliability of model

The following conditions are required for reliability and validity of the model:

- Reliability: Composite Reliability (CR) > 0.7 and loadings on factors > 0.5
- Convergent validity: CR > Average Variance Extracted (AVE) and AVE > 0.5
- Discriminant validity: AVE > squared correlations

For this model, Table 2 shows the values of the indices used to assess for reliability and validity, based on the conditions specified above. Diagonals represent AVE and Alpha represents Cronbach's alpha reliability measure. Off diagonals represent squared correlations (also known as shared variance).

Table 2: Squared correlations, composite reliability, average variance extracted and Cronbach's alpha for current model

	Squared correlations				
Construct	**Factor 1**	**Factor 2**	**Factor 3**	**CR**	**Cronbach's Alpha**
Factor 1	0.632			0.932	0.934
Factor 2	0.484	0.639		0.775	0.715
Factor 3	0.619	0.576	0.631	0.773	0.763

Source: Author developed

All reliability and validity conditions have been met, thus rendering the model reliable and valid.

6.2. Critical Success Factors for Lean initiation

Critical Success Factors (CSF) is defined as "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organisation" (Rockart 1979:85). Three CSFs for the successful initiation of Lean in South African public hospitals have been identified. Each CSF consists of elements which itemise the factor (see Table 3). The elements of each factor provide a brief statement of the key requirements for

healthcare managers to consider prior to the initiation of Lean in public hospitals, the absence of which may impede successful Lean rollout.

Table 3: Critical Success Factors for Lean initiation in hospitals

Critical Success Factors	Elements (taken from test items)
CSF 1: **Strategic Leadership and Organisational Attitude**	L1: Leadership at all levels in the organisation must drive, live and demonstrate Lean behaviour.
	A2: An organisation implementing Lean must face and embrace the various attitudinal aspects of Lean.
	S1: Lean philosophy and principles must be reflected in the organisation's business strategy.
	L2: Lean leadership leads to Lean thinking.
	S3: Lean implementation must be driven as a high priority strategic business initiative.
	L4: The difference between Lean success and failure starts with leadership.
	A1: The mind-set and attitude or behaviour of people is fundamental to Lean success.
	S2: There must be a clear link between the organisation goals, key objectives and Lean activities.
CSF 2: **Integration of Lean elements, tools and techniques**	I4: The organisation must use all of the goals, methods, techniques and foundation elements of Lean in combination
	T4: The application of Lean tools and techniques will ensure Lean success.
CSF 3: **Basic stability in operational processes**	T3: It is important to understand the organisation's processes and only apply the Lean tools and techniques applicable to that specific process type.
	B4: Stability in operating systems is a pre-requisite for Lean transformation.

Source: Author developed

7. DISCUSSION

7.1 Development of the Lean SPRInT

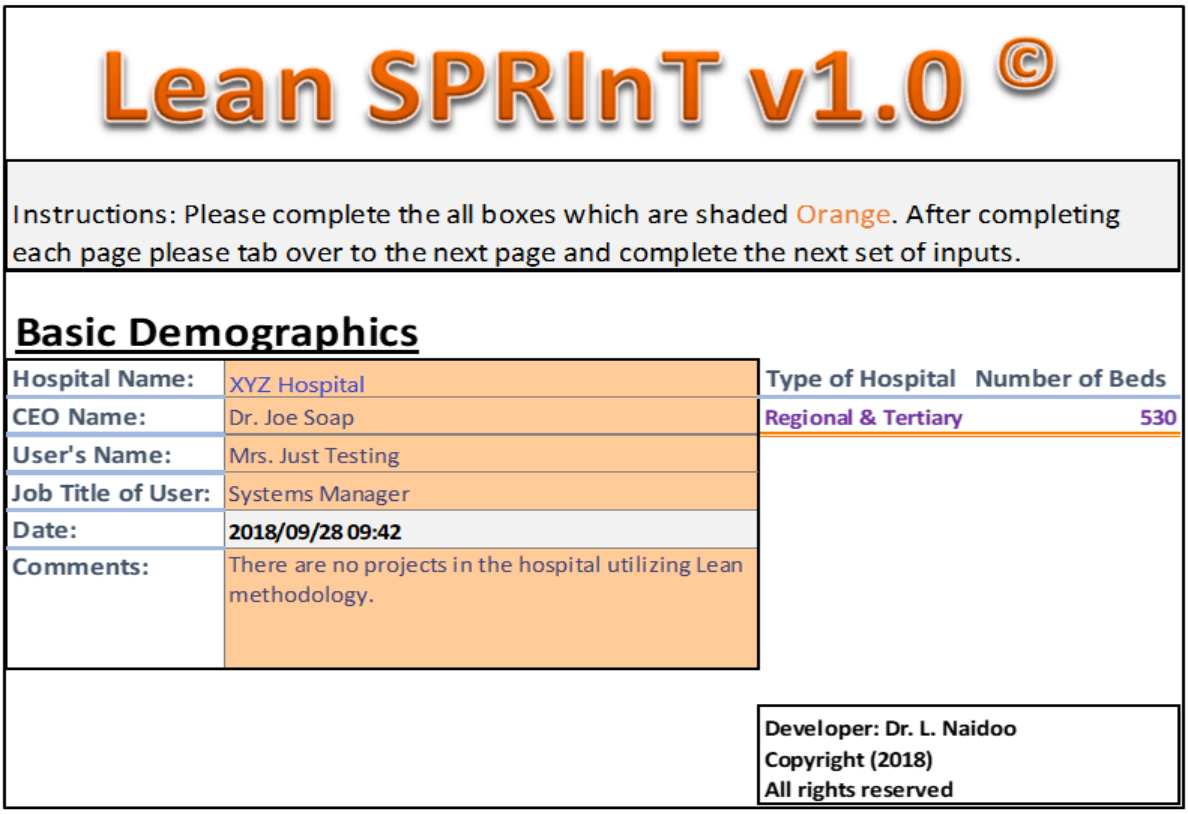
The three CSFs identified through factor analysis and SEM are considered robust predictors of indicating success of Lean initiation in hospitals as all reliability and validity conditions have been met. The Lean SPRInT is a user-friendly success prediction instrument that can be used as a yardstick for healthcare managers to ascertain in advance the state of readiness of public hospitals for Lean initiation. It was developed from the three CSFs which

have been integrated into an electronic tool. Lean SPRInT captures managers' inputs and produces readiness ratings and guidance processes for successful Lean initiation.

Lean SPRInT version 1.0 currently uses a Microsoft® Excel platform and user interface. Demographics and user details are captured on the landing screen (Figure 3). For public hospitals in KZN, there is a drop-down menu to select a hospital name from and the hospital classification and its number of beds is displayed automatically from a back-end database.

Thereafter the user switches over to the Lean success predictor input screen (Figure 4). Each CSF element formed the backbone of the Lean SPRInT success predictor input interface. The Lean success predictor input screen requires the user to select ratings from a drop-down menu, based on a Likert scale ("strongly agree"=4, "agree"=3, "disagree"=2 and "strongly disagree"=1), for each element as an indication of their degree of existence or applicability to their organisation's current environment in terms of Lean readiness. See Figure 3 for Lean SPRInT landing screen for input of demographic and user details.

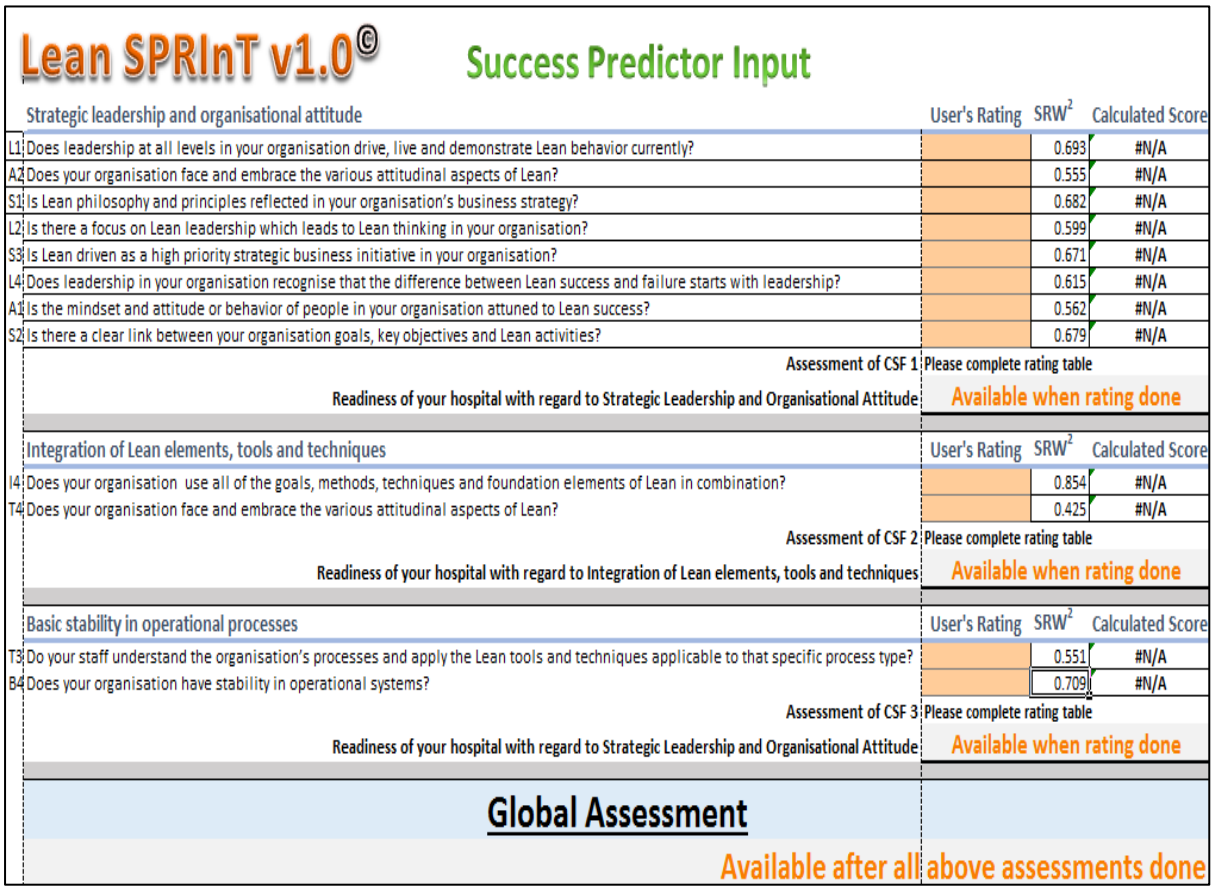
Figure 3: Lean SPRInT landing screen for input of demographic and user details



Source: Author developed

See Figure 4 for Lean SPRInT success predictor input screen.

Figure 4: Lean SPRInT Success Predictor Input Screen



Lean SPRInT v1.0©

Success Predictor Input

	Strategic leadership and organisational attitude	User's Rating	SRW^2	Calculated Score
L1	Does leadership at all levels in your organisation drive, live and demonstrate Lean behavior currently?		0.693	#N/A
A2	Does your organisation face and embrace the various attitudinal aspects of Lean?		0.555	#N/A
S1	Is Lean philosophy and principles reflected in your organisation's business strategy?		0.682	#N/A
L2	Is there a focus on Lean leadership which leads to Lean thinking in your organisation?		0.599	#N/A
S3	Is Lean driven as a high priority strategic business initiative in your organisation?		0.671	#N/A
L4	Does leadership in your organisation recognise that the difference between Lean success and failure starts with leadership?		0.615	#N/A
A1	Is the mindset and attitude or behavior of people in your organisation attuned to Lean success?		0.562	#N/A
S2	Is there a clear link between your organisation goals, key objectives and Lean activities?		0.679	#N/A
	Assessment of CSF 1	Please complete rating table		
	Readiness of your hospital with regard to Strategic Leadership and Organisational Attitude	Available when rating done		

	Integration of Lean elements, tools and techniques	User's Rating	SRW^2	Calculated Score
I4	Does your organisation use all of the goals, methods, techniques and foundation elements of Lean in combination?		0.854	#N/A
T4	Does your organisation face and embrace the various attitudinal aspects of Lean?		0.425	#N/A
	Assessment of CSF 2	Please complete rating table		
	Readiness of your hospital with regard to Integration of Lean elements, tools and techniques	Available when rating done		

	Basic stability in operational processes	User's Rating	SRW^2	Calculated Score
T3	Do your staff understand the organisation's processes and apply the Lean tools and techniques applicable to that specific process type?		0.551	#N/A
B4	Does your organisation have stability in operational systems?		0.709	#N/A
	Assessment of CSF 3	Please complete rating table		
	Readiness of your hospital with regard to Strategic Leadership and Organisational Attitude	Available when rating done		

Global Assessment

Available after all above assessments done

Source: Author developed

At the back end of Lean SPRInT, the Squared Multiple Correlations (communalities) or squares of the Standardised Regression Weights (SRW^2) are used as weights for each of the elements in the input interface. These weights together with the users input ratings (1 to 4) generate products (calculated scores) for each element, i.e. user rating x SRW^2. Figure 5, Figure 6 and Figure 7 show examples of simulated user inputs, SRW^2 (weights) and calculated scores for CSF 1, CSF 2 and CSF 3 elements respectively.

Figure 5: Simulated user inputs, SRW2 (weights) and calculated scores for CSF 1 elements

	Strategic leadership and organisational attitude	User's Rating	SRW^2	Calculated Score
L1	Does leadership at all levels in your organisation drive, live and demonstrate Lean behavior currently?	Agree	0.693	**2.079**
A2	Does your organisation face and embrace the various attitudinal aspects of Lean?	Agree	0.555	**1.665**
S1	Is Lean philosophy and principles reflected in your organisation's business strategy?	Strongly Agree	0.682	**2.728**
L2	Is there a focus on Lean leadership which leads to Lean thinking in your organisation?	Strongly Disagree	0.599	**0.599**
S3	Is Lean driven as a high priority strategic business initiative in your organisation?	Strongly Agree	0.671	**2.684**
L4	Does leadership in your organisation recognise that the difference between Lean success and failure starts with leadership?	Strongly Agree	0.615	**2.46**
A1	Is the mindset and attitude or behavior of people in your organisation attuned to Lean success?	Strongly Agree	0.562	**2.248**
S2	Is there a clear link between your organisation goals, key objectives and Lean activities?	Disagree	0.679	**1.358**

Source: Author developed

Figure 6: Simulated user inputs, SRW2 (weights) and calculated scores for CSF 2 elements

Integration of Lean elements, tools and techniques	User's Rating	SRW^2	Calculated Score
Does your organisation use all of the goals, methods, techniques and foundation elements of Lean in combination?	Strongly Agree	0.854	**3.416**
Does your organisation face and embrace the various attitudinal aspects of Lean?	Strongly Disagree	0.425	**0.425**

Source: Author developed

Figure 7: Simulated user inputs, SRW2 (weights) and calculated scores for CSF 3 elements

Basic stability in operational processes	User's Rating	SRW^2	Calculated Score
Do your staff understand the organisation's processes and apply the Lean tools and techniques applicable to that specific proc	Strongly Agree	0.551	**2.204**
Does your organisation have stability in operational systems?	Agree	0.709	**2.127**

Source: Author developed

The maximum calculated score for each element is the product of 4 (maximum possible user rating) and the SRW^2 for that element, whereas the minimum calculated score is the product of 1 (minimum possible user rating) and the SRW^2 for that element. The sum of the maximum calculated scores for the elements of a particular CSF provides the maximum calculated score for that CSF. Likewise, the sum of the minimum calculated scores for the elements of a particular CSF provides the minimum calculated score for that CSF.

The overall range of scores for a CSF is divided equally into three sub-categories or tripartite ranges which correlate with a particular Lean readiness level (1, 2 or 3) for that CSF. The Lean readiness level for a CSF is then determined by placing the total calculated score for a particular CSF within one of the tripartite ranges for that CSF (Table 4). The overall range of scores for the final prediction of Lean readiness for the organisation is also divided equally into three subcategories (Table 4) which correlate with an organisational Lean readiness level (1, 2 or 3).

Table 4: Minimum and maximum scores for the different Lean readiness levels in terms of the three CSFs and the overall total score

		Category	Minimum score (1x SRW²)	Maximum score (4x SRW²)	Readiness levels
Scores for Total	7.595-15.19	Total	7,595	15,19	Readiness level 1
	15.20-22.785	Total	15,2	22,785	Readiness level 2
	22.786-30.38	Total	22,786	30,38	Readiness level 3
Scores for CSF1	5.056-10.112	CSF1	5,056	10,112	Readiness level 1
	10.113-15.168	CSF1	10,113	15,168	Readiness level 2
	15.169-20.224	CSF1	15,169	20,224	Readiness level 3
Scores for CSF2	1.279-2.558	CSF2	1,279	2,558	Readiness level 1
	2.559-3.837	CSF2	2,559	3,837	Readiness level 2
	3.838-5.116	CSF2	3,838	5,116	Readiness level 3
Scores for CSF3	1.26-2.52	CSF3	1,26	2,52	Readiness level 1
	2.53-3.78	CSF3	2,53	3,78	Readiness level 2
	3.79-5.04	CSF3	3,79	5,04	Readiness level 3

Source: Author developed

Lean SPRInT's output screen (Figure 8) with calculated Lean readiness levels, ranging from 1 to 3 (most unfavourable to most favourable prediction of readiness, respectively), is supplemented by commentary and recommendations to the user. These recommendations succinctly provide managers with a practical conduit to deploy resources without having to embark on the Lean journey blindly. This ensures that the ultimate aim of Lean SPRInT to determine upfront the state of Lean readiness is met by managers capturing inputs and the tool producing readiness ratings and recommendations for successful Lean initiation.

The culmination of the research in a tool that is both user-friendly and simple to use by healthcare managers wanting to introduce Lean in their institutions augurs well for the Lean body of knowledge.

Figure 8: Lean SPRInT simulated outputs

Lean SPRInT v1.0© **Success Predictor Input**

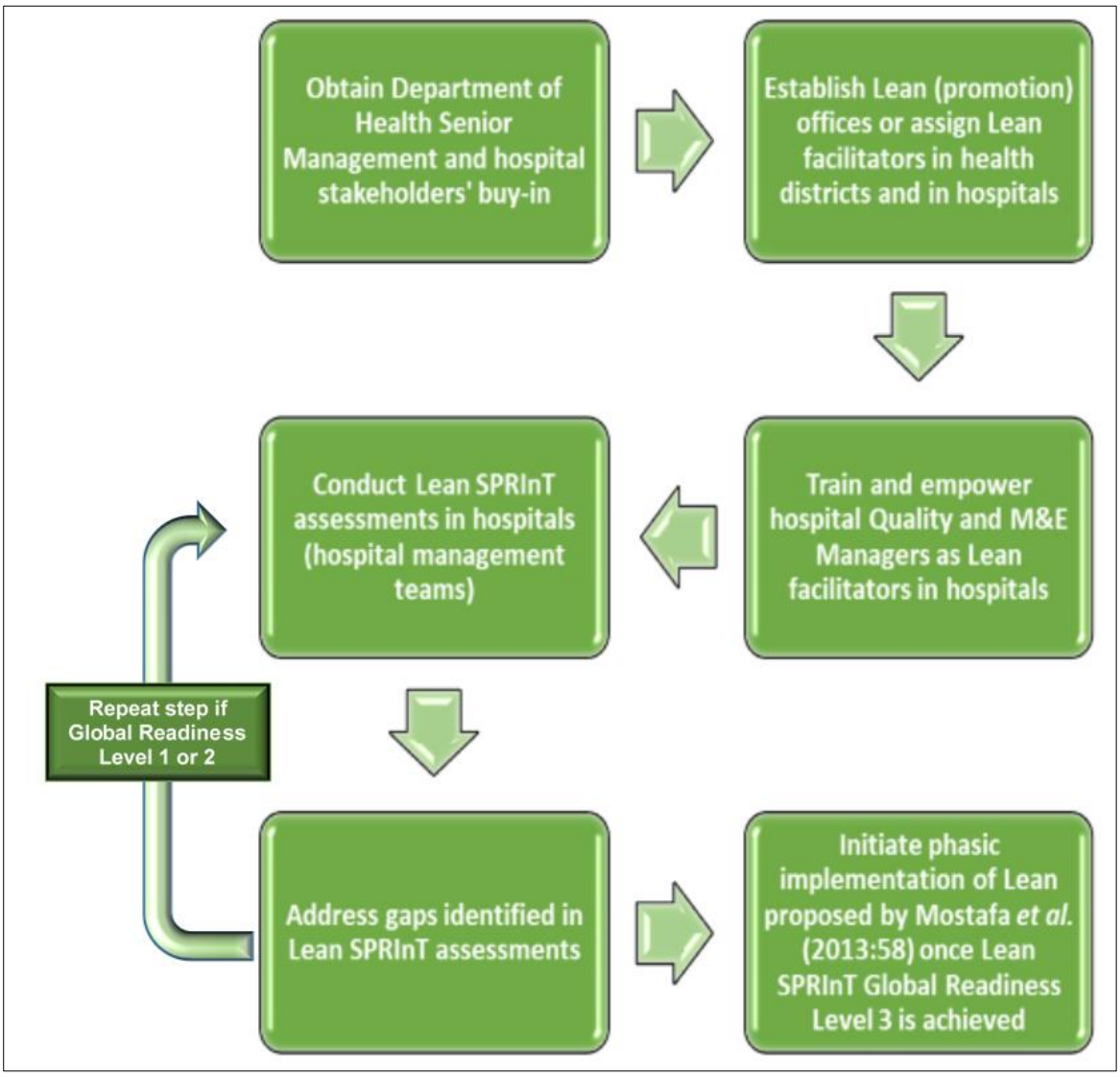
	Strategic leadership and organisational attitude	User's Rating	SRW²	Calculated Score
L1	Does leadership at all levels in your organisation drive, live and demonstrate Lean behavior currently?	Agree	0.693	2.079
A2	Does your organisation face and embrace the various attitudinal aspects of Lean?	Disagree	0.555	1.11
S1	Is Lean philosophy and principles reflected in your organisation's business strategy?	Strongly Agree	0.682	2.728
L2	Is there a focus on Lean leadership which leads to Lean thinking in your organisation?	Strongly Agree	0.599	2.396
S3	Is Lean driven as a high priority strategic business initiative in your organisation?	Agree	0.671	2.013
L4	Does leadership in your organisation recognise that the difference between Lean success and failure starts with leadersh	Agree	0.615	1.845
A1	Is the mindset and attitude or behavior of people in your organisation attuned to Lean success?	Strongly Disagre	0.562	0.562
S2	Is there a clear link between your organisation goals, key objectives and Lean activities?	Strongly Agree	0.679	2.716
	Assessment of CSF 1	15.449		
	Readiness of your hospital with regard to Strategic Leadership and Organisational Attitude	Readiness level 3		
	Integration of Lean elements, tools and techniques	**User's Rating**	**SRW²**	**Calculated Score**
I4	Does your organisation use all of the goals, methods, techniques and foundation elements of Lean in combination?	Disagree	0.854	1.708
T4	Does your organisation face and embrace the various attitudinal aspects of Lean?	Agree	0.425	1.275
	Assessment of CSF 2	2.983		
	Readiness of your hospital with regard to Integration of Lean elements, tools and techniques	Readiness level 2		
	Basic stability in operational processes	**User's Rating**	**SRW²**	**Calculated Score**
T3	Do your staff understand the organisation's processes and apply the Lean tools and techniques applicable to that specifi	Strongly Agree	0.551	2.204
B4	Does your organisation have stability in operational systems?	Strongly Agree	0.709	2.836
	Assessment of CSF 3	5.04		
	Readiness of your hospital with regard to Strategic Leadership and Organisational Attitude	Readiness level 3		
	Global Assessment	23.472		
	Grey's Hospital: Readiness level 3			

Source: Author developed

7.2 Rollout of the Lean SPRInT

It is envisaged that Lean SPRInT could be adopted by the South African Department of Health, starting with the provincial hospitals in KZN, to assess the state of readiness for Lean initiation. The proposed 6 steps for the deployment of Lean SPRInT prior to the initiation of Lean in public hospitals are represented in Figure 9.

Figure 9: Six steps for the deployment of Lean SPRInT prior to Lean initiation in public hospitals



Source: Author developed.

The foremost step involves obtaining buy-in from the KZN Head of Health and top management, and subsequently meeting with the district and hospital managers to introduce the tool and its purpose.

As the second step, the possibility of allocating a Lean (promotion) office as a Lean "helpdesk" in every health district should be considered. This office would be responsible for guiding hospitals within their jurisdiction with the use of Lean SPRInT. This office must place focus on "how to stay" rather than "how to be" Lean in order to avoid hospitals returning to their previous comfort zones after Lean rollout (Freitas, Freitas, Gomes de Menezes & Odorczyk 2018; Machado Guimarães & Crespo de Carvalho 2014:7). Lean (promotion)

offices in health districts can be a shared resource for hospitals rolling out Lean and could be incorporated into existing district Monitoring and Evaluation (M&E) Management or Quality Management offices (Freitas *et al*. 2018; Goehnera, Mello & Bandeira 2016:39).

The third step is training of key staff, such as Quality and M&E Managers at hospital level, on the Lean SPRInT. This is a crucial step as it supports the maintenance and promotion of Lean at the coalface. According to the World Health Organisation (2007), "good leadership and management are about providing direction to, and gaining commitment from, partners and staff, facilitating change and achieving better health services through efficient, creative and responsible deployment of people and other health resources" (Doherty 2013:7; World Health Organisation 2007:1). Doherty (2013:9) cites the theory of "street-level bureaucrats", who, in health facilities, are the front-line workers such as doctors and nurses with direct patient and family contact, and make decisions on a daily basis at the 'coalface' on resource deployment and healthcare options which affects the performance of the institution. The degree of clinical leadership demonstrated in these "street-level bureaucrats" inevitably influences the operational efficiency at which the organisation performs.

Considering the above, training on the deployment of Lean SPRInT must target key stakeholders from hospitals, including Quality and M&E Managers and frontline clinician leaders. Hospital Quality or M&E Managers could be assigned as Lean facilitators within the hospitals. The training could include serial workshops on the functional and technical aspects of Lean SPRInT, interpretation of the outputs of Lean SPRInT and the possible options to consider as next steps for achieving Lean readiness. Lean experts from the Lean Institute of Africa could be invited to facilitate these workshops jointly with the developer of Lean SPRInT.

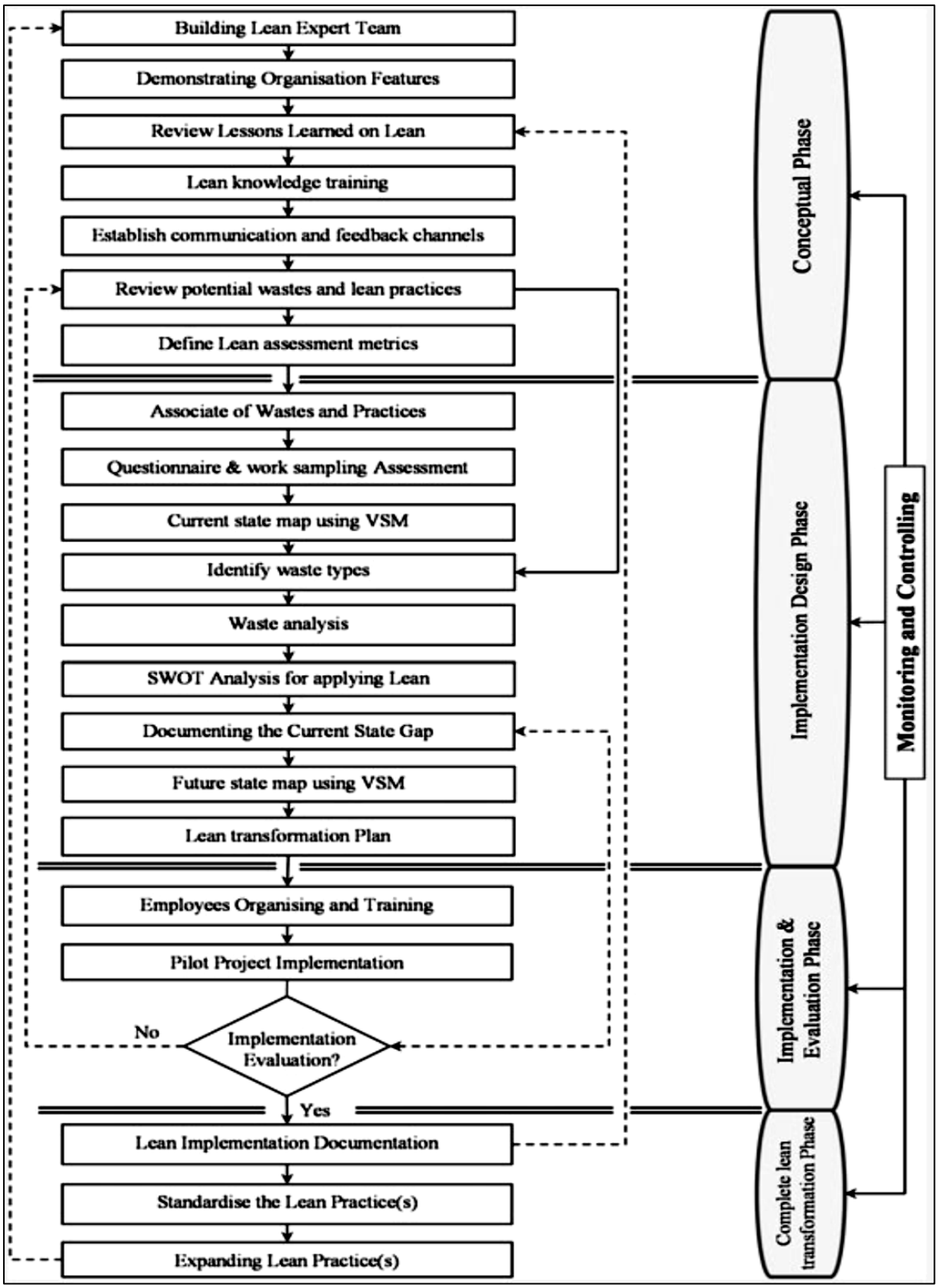
The fourth step is the actual application of the Lean SPRInT. It is proposed that the tool be completed by a joint sitting of top management of the hospital. It is imperative that the key managers assign, through consensus, ratings for each of the CSF elements in the tool. In step 5, gaps identified in terms of not meeting the CSF criteria for readiness of Lean initiation must be addressed, preferably through a formal action plan with activities and responsible persons for carrying out these activities with strict timeframes. The Lean SPRInT must then be applied iteratively and periodically in a follow up sitting of top management to assess progress made in addressing the initial gaps identified. Only once a Global Readiness Level of 3 is achieved should the initiation of Lean be considered (Step 6).

It is posited that implementation frameworks have highest success rates for Lean initiation (Mostafa, Dumrak & Soltan 2013:60). Although the output of Lean SPRInT doesn't consider sequenced Lean implementation, it is advisable that a phasic approach for Lean initiation is followed in Step 6 (Mostafa *et al*. 2013:54-60). A useful model is depicted in Figure 10, where Lean implementation commences with a Conceptual Phase, then moves to an Implementation Design Phase, an Implementation and Evaluation Phase, and finally a Complete Lean Transformation Phase.

It has been suggested that unified efforts of clinical and non-clinical services in healthcare facilities, decentralised clinical and managerial decision-making and culture transformation are more likely to lead to better outcomes (Doherty 2013:35). Lean fosters these characteristics, and if effectively inculcated in and practised by leaders at all levels within healthcare institutions, it is likely to lead to improvement in operational efficiency, thus narrowing the strategy intervention-implementation gap depicted in Figure 2.

See Figure 10 for the proposed framework for phasic Lean implementation.

Figure 10: A proposed framework for phasic Lean implementation

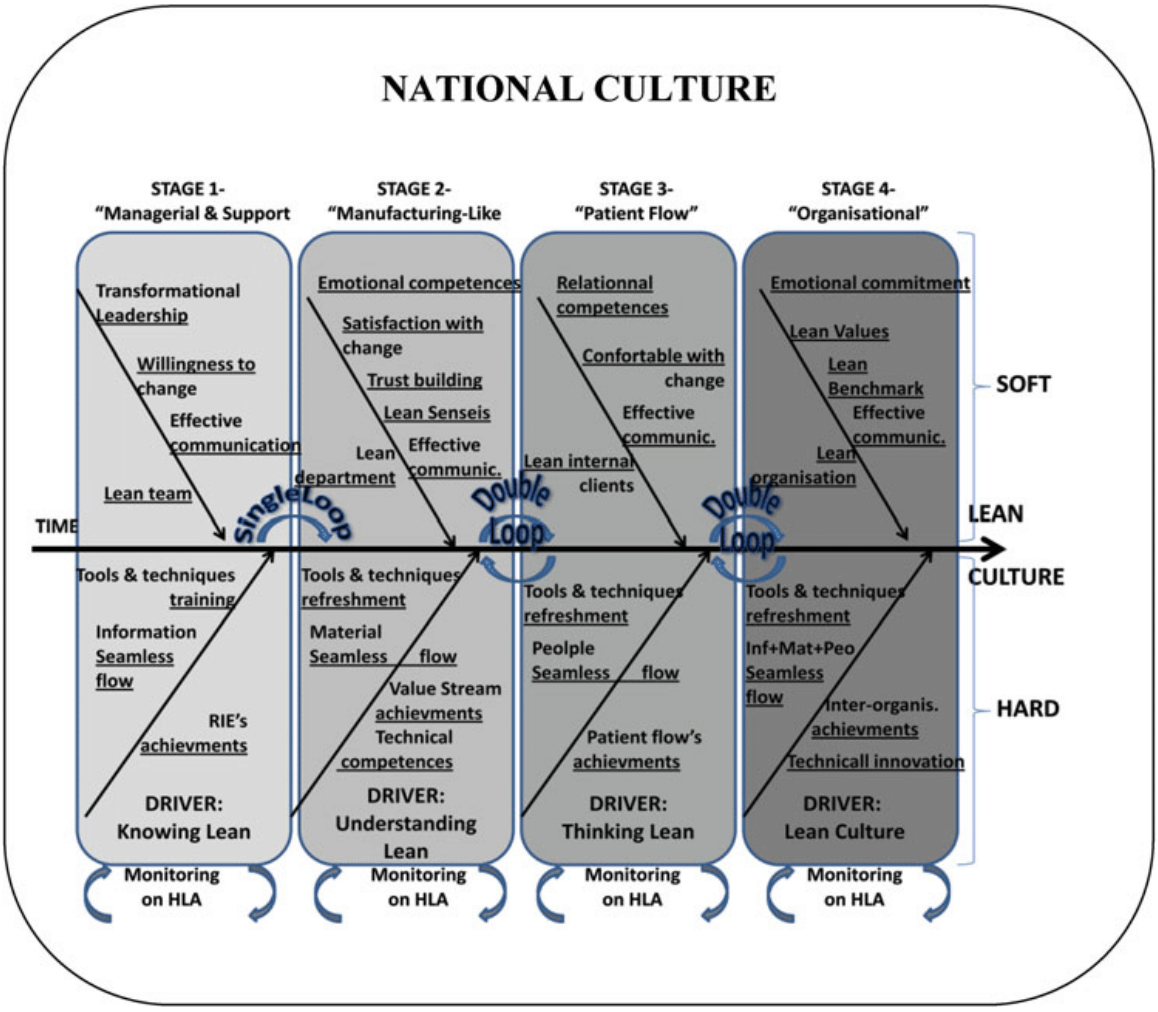


Source: Mostafa *et al*. (2013:58)

7.3 Monitoring the implementation of Lean

The success of Lean implementation is also determined by its monitoring and controls to prevent slippage. Lean SPRInT is not a monitoring tool, as it does not assess the degree of improvements made nor the pitfalls during Lean implementation. The Healthcare Lean Assessment tool (HLA) has been proposed as a useful monitoring instrument for providing a current-state diagnosis of the implementation process along the different Lean maturity levels thus guiding the Lean journey (Machado Guimarães & Crespo de Carvalho 2014:15-21). As Lean transformation matures from Lean initiation, with intertwining training on soft (human aspects) and hard skills (Lean tools and techniques), the hospital would proceed through four stages as depicted in Figure 11. Lean SPRInT would precede Stage 1.

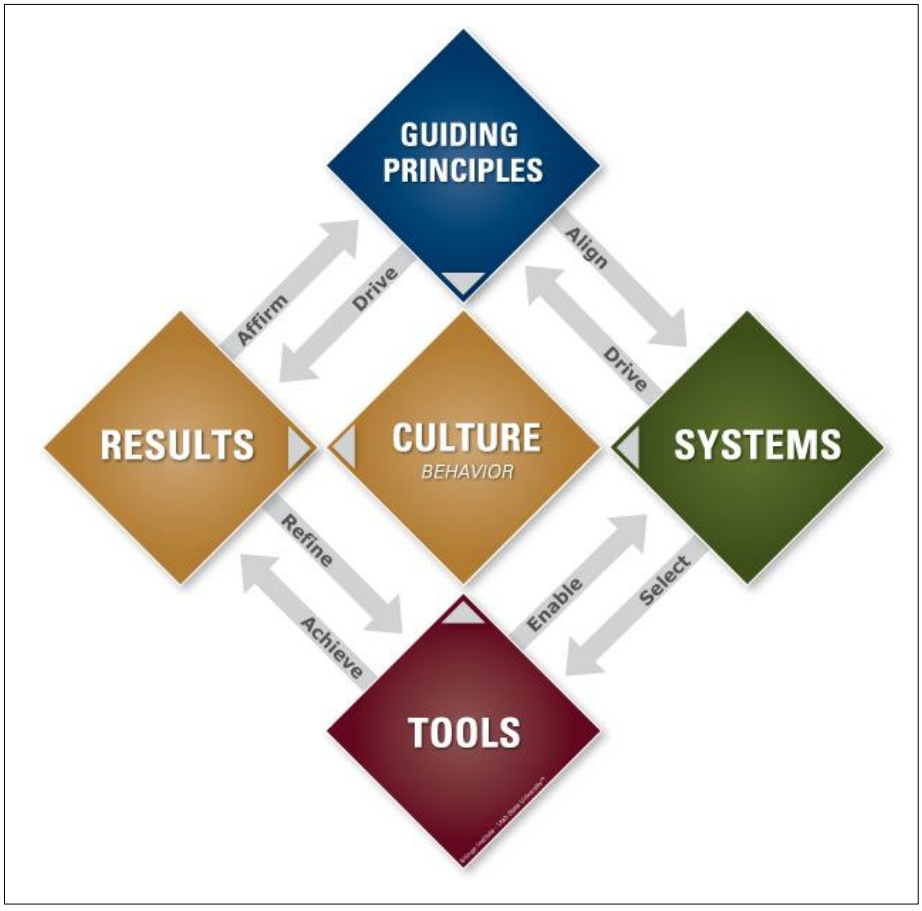
Figure 11: Lean maturity model in healthcare organisations



Source: Machado Guimarães and Crespo de Carvalho (2014: 8)

The HLA tool is based on the Shingo transformational model known as the Shingo diamond (Figure 12), which reinforces a systematic approach to ongoing improvement (Machado Guimarães & Crespo de Carvalho 2014:14). The Shingo diamond demonstrates the interrelationship amongst guiding principles, systems, tools and results, all of which effectively influence the culture of the organisation. The HLA tool assesses whether each process in the maturity model (Figure 11) should be improved disrupted or eliminated and can be used as an ongoing implementation assessment, providing control measures and corrective actions.

Figure 12: The Shingo transformational model



Source: Shingo Institute (2018)

8. MANAGEMENT IMPLICATIONS

Lean SPRInT's output of calculated Lean readiness levels for each of the CSF elements allow managers to gauge the deficiencies in their institution, which once improved, would portend for a more favourable prediction of success. Lean SPRInT as a success predictor instrument is by no means the panacea for Lean implementation in hospitals, but prepares managers embarking on a Lean journey by providing them with a current-state assessment

of their organisation in terms of the elements of the 3 CSFs. The use of Lean SPRInT should be integrated in a phasic Lean implementation framework such that the assessment outputs will facilitate appropriate resource deployment as the Lean journey progress from one phase to the next.

9. AREAS FOR FUTURE RESEARCH

Future research to evaluate the effectiveness and practicality of Lean SPRInT is recommended. Research on the utilization or uptake of Lean SPRInT in public hospitals, and correlation of the findings with the successful initiation of Lean will be very useful to determine the value of the tool. A survey on the attitudes and perceptions of senior managers with regard to Lean SPRInT will provide useful information for the developer to consider in refining the tool.

10. LIMITATIONS OF THE STUDY

The researcher experienced difficulty in reaching the target population and delayed response times due to the geographical spread of the public hospitals, some with information technology and network difficulties. There were also some management posts that were vacant with the high staff turnover rate, often with people erratically acting in those positions. Most of these limitations were addressed by close follow up with the local health district offices and district quality and information managers, which support respective hospitals. A research assistant was also used to distribute and collect questionnaires, and follow up responses from participants.

11. CONCLUSIONS

The organisational strategy roadmap is guided by strategic vision and goals and is often laden with barriers and enablers which widen or narrow the intervention-implementation gap, respectively. Lean is both a catalyst for interventions and an intervention itself which maximises output with minimal resource inputs by "doing better with less" (Omogbai & Salonitis 2016:106; Røvik & Andersen 2015:1; Womack *et al*. 2007:1). The Lean SPRInT is proposed as a management tool for assessing hospitals' readiness status for Lean initiation prior to embarking on a Lean transformation journey.

Lean SPRInT utilizes a scoring system for assessing the degree of readiness for Lean initiation in accordance with three critical success factors (CSFs): (1) Strategic leadership and organisational attitude; (2) Integration of Lean elements, tools and techniques, and (3) Basic stability in operational processes. The culmination of this study in a tool that is both

user-friendly and simple to use by managers wanting to initiate Lean in their hospitals augurs well for the Lean body of knowledge.

A six-step process for the deployment of Lean SPRInT in public hospitals is proposed in this article. Top management buy-in precedes the establishment of Lean promotion offices and/or facilitators using existing resources such as Quality and M&E Managers as shared resources within health districts. Empowerment of these officials through training is essential. Lean SPRInT assessments of hospitals must be carried out by hospital management teams, facilitated by Quality and M&E Managers, and identified gaps addressed through a structured approach. Lean SPRInT assessments and addressing shortfalls are repeated in an iterative process until the tool predicts a Global Readiness Level of 1, heralding the readiness to proceed with Lean initiation. A phasic approach for Lean implementation, together with close monitoring to prevent slippage using the HLA tool is recommended.

It is suggested that unified efforts of clinical and non-clinical services in healthcare facilities, decentralised clinical and managerial decision-making and culture transformation are more likely to lead to better outcomes of Lean initiation (Doherty 2013:35). Such an approach is likely to sustainably improve operational efficiency and narrow the strategic intervention-implementation gap for successfully achieving targeted health outcomes.

COMPETING INTERESTS

None.

AUTHORS' CONTRIBUTIONS

Logandran Naidoo conducted the research and produced the report. Ziska Fields supervised the research.

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REFERENCES

BECK K, BEEDLE M, BENNEKUM A, COCKBURN A, CUNNINGHAM W, FOWLER M, GRENNING J, HIGHSMITH J, HUNT A, JEFFRIES R, KERN J, MARICK B, MARTIN R, MELLOR S, SCHWABER K, SUTHERLAND J & THOMAS D. 2001. Manifesto for Agile Software Development. Corryton: Agile Alliance. [Internet:http://www.agilemanifesto.org/; downloaded on 03 July 2019.]

BURGESS N & RADNOR Z. 2013. Evaluating Lean in healthcare. *International Journal of Health Care Quality Assurance* 26:220-235.

BUJANG MA, OMAR ED & BAHARUM NA. 2018. A Review on Sample Size Determination for Cronbach's Alpha Test: A Simple Guide for Researchers. *The Malaysian Journal of Medical Sciences* : *MJMS* 25(6):85-99. [Internet:https://www.ncbi.nlm.nih.gov/pubmed/ 30914882; downloaded on 28 April 2019]. (DOI:10.21315/mjms2018.25.6.9.)

DICKSON EW, SINGH S, CHEUNG DS, WYATT CC & NUGENT AS. 2009. Application of lean manufacturing techniques in the emergency department. *Journal of emergency medicine* 37:177-182.

DOHERTY J. 2013. Strengthening clinical leadership in hospitals: A review of the international and South African literature. Johannesburg: The Municipal Services Project, School of Government, University of the Western Cape.

FAITH M, KIM N & HEO M. 2015. Statistical power as a function of Cronbach alpha of instrument questionnaire items. *BMC Medical Research Methodology* 15(1):1-9. (DOI:10.1186/s12874-015-0070-6.)

FREITAS RDC, FREITAS MDCD, GOMES DE MENEZES G & ODORCZYK RS. 2018. Lean Office contributions for organizational learning. *Journal of Organizational Change Management* 31(5):1027-1039. (DOI:10.1108/JOCM-06-2017-0221.)

GOEHNERA L, MELLO LCBB & BANDEIRA RAM. 2016. Lean Manufacturing Implementation for Multinational Companies with Production Subsidiary in Brazil: Development of A Roadmap. *International Journal of Lean Thinking* 7(1):26-46.

IMPROTA G, ROMANO M, DI CICCO MV, FERRARO A, BORRELLI A, VERDOLIVA C & CESARELLI M. 2018. Lean thinking to improve emergency department throughput at AORN Cardarelli hospital. *BMC Health Services Research* 18(1):1-9. (DOI:10.1186/s12913-018-3654-0.)

JHA RK, SAHAY BS & CHARAN P. 2016. Healthcare operations management: a structured literature review. *DECISION* 43:259-279.

KUNDU G & MANOHAR BM. 2012. Critical success factors for implementing lean practices in I.T. support services. *International Journal for Quality research* 6:301-312.

KZN DEPARTMENT OF HEALTH. 2018a. KwaZulu-Natal Department of Health Annual Report 2017/18 - Vote 7. Pietermaritzburg: KZN Department of Health.

KZN DEPARTMENT OF HEALTH. 2018b. KwaZulu-Natal Department of Health Annual Performance Plan 2018/19 - 2020/21. Pietermaritzburg: KZN Department of Health.

KYRIAZOS TA. 2018. Applied Psychometrics: Sample Size and Sample Power Considerations in Factor Analysis (EFA, CFA) and SEM in General. *Psychology* 09:2207-2230.

MACCALLUM RC, WIDAMAN KF, ZHANG S & HONG S. 1999. Sample size in factor analysis. *Psychological Methods* 4(1):84-99.

MACHADO GUIMARÃES C & CRESPO DE CARVALHO J. 2014. Assessing Lean Deployment in Healthcare-A Critical Review and Framework. *Journal of Enterprise Transformation* 4(1):3-27. [Internet:https://doi.org/10.1080/19488289.2013.869277; downloaded on 24 March 2019]. (DOI:10.1080/19488289.2013.869277.)

MADUBULA N, ENGLISH RG, PADAYACHEE T & MKHIZE M. 2014. Adequacy and Efficiency in Primary Health Care Financing. Technical Report: Submission for the Division of Revenue 2015/2016. Midrand: Financial and Fiscal Commission.

MAYOSI BM & BENATAR SR. 2014. Health and Healthcare in South Africa - 20 Years after Mandela. *New England Journal of Medicine* 371(14):1344-1353. [Internet:http://www.nejm.org/doi/full/10.1056/ NEJMsr1405012; downloaded on 14 March 2019]. (DOI:doi:10.1056/NEJMsr1405012.)

MOSTAFA S, DUMRAK J & SOLTAN H. 2013. A framework for lean manufacturing implementation. *Production & Manufacturing Research* 1(1):44-64. [Internet:http://dx.doi.org/10.1080/21693277. 2013.862159; downloaded on 28 February 2019]. (DOI:10.1080/21693277.2013.862159.)

OMOGBAI O & SALONITIS K. 2016. A Lean Assessment Tool Based on Systems Dynamics. *Procedia CIRP* 50:106-111. [Internet:http://www.sciencedirect.com/science/ article/pii/S2212827116304097; downloaded on 19 August 2018]. (DOI:https://doi.org/10.1016/j.procir.2016.04.169.)

REDDY A. 2016. The Scrumban [r]evolution: Getting the most out of Agile, Scrum and Lean kanban. New York City: Pearson Education Inc.

ROCKART JF. 1979. Chief executives define their own data needs. *Harvard Business Review* 57(2):81-93. (March-April.)

RØVIK K & ANDERSEN H. 2015. Lost in translation: a case-study of the travel of lean thinking in a hospital. *BMC Health Services Research* 15(1):1-9. (DOI:10.1186/s12913-015-1081-z.)

SCHUMACKER RE & LOMAX RG. 2015. A Beginner's Guide to Structural Equation Modeling. 4th ed. New York: Routledge.

SHINGO INSTITUTE. 2018. The Shingo model. [Internet:https://shingo.org/model; downloaded on 24 March 2019.]

SRINIVASARAGHAVAN J & ALLADA V. 2006. Application of mahalanobis distance as a lean assessment metric. *Int J Adv Manuf Technol The International Journal of Advanced Manufacturing Technology* 29:1159-1168.

SUTHERLAND J & SCHWABER K. 2013. The Scrum Guide: The Definitive Guide to Scrum: The Rules of the Game. Boston: Scrum.org.

TABER KS. 2018. The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education* 48(6):1273-1296. [Internet:https://doi.org/10.1007/s11165-016-9602-2; downloaded on 28 April 2019]. (DOI:10.1007/s11165-016-9602-2.)

WOMACK JP, JONES DT & ROOS D. 2007. The machine that changed the world. New York: Simon & Schuster.

WORLD HEALTH ORGANISATION. 2007. Building leadership and management capacity in health. Geneva: World Health Organisation.

YIP W & HAFEZ R. 2015. Reforms for improving the efficiency of health systems: lessons from 10 country cases. Geneva: WHO Press.

ZIDEL TG. 2006. A lean toolbox-using lean principles and techniques in healthcare. *Journal for Healthcare Quality* 28:W1-7.