

Influence of Lean Practice on Performance of Manufacturing SMEs in Kurdistan Region of Iraq (KRI)

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Influence of Lean practices on performance of manufacturing

SMEs in KRI

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Abstract

KRI is a developing region in the Middle East. After 2003, KRI manufacturing sector was fostered to provide better products to successfully compete with foreign goods in order to contribute to the economic reform and improve the industry sector. Lean manufacturing (LM) is an internationally acclaimed perfection initiative that can create continuous improvement in business performance through eliminating waste, minimising production cycle time, reducing operational cost and promoting value-added activities. This study aims to empirically examine the influences of LM practices on the SMEs business performance. A comprehensive review of LM literature was conducted, and seven variables were present that dominate LM practices in KRI, including lean leadership, customer relationship management, strategic planning, continuous development, human resource development, process management and organisational learning. Data were collected and analysed from 207 manufacturing SMEs in the KRI showing that LM practice partially influences the business performance. The findings of this study could support implacability of LM in the SMEs of developing countries. It also provides valuable information for SMEs managers to improve the performance of their business in terms of customer satisfaction, profitability increase, employee's satisfaction, competitiveness growth and ergonomics improvement.

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Keywords: Lean, Manufacturing SMEs, Performance, KRI.

1. Introduction

To compete successfully in the twenty-first century's global and fast-changing environment, enterprises around the world ought to be able to decrease waste, cost and enhance quality across their operational processes [1]. LM is a proven method to reduce waste, effort and cost anywhere in a company, improve resource consumption and promote an organisational culture emphasised on continuously increasing customer satisfaction [2, 3, 4]. Over the past three decades, the level of awareness of LM has increased significantly among western companies [5, 6]. Womack and Jones [7] believed that LM applies to all enterprises, regardless of their size, country or organisational cultures.

The ongoing expansion of information technology provides unique opportunities for SMEs to implement LM operations at different levels [8, 9, 10, 11].

LM experience in developing countries is at a low level. From 1996 to the first quarter of 2012, only 14% of studies were conducted in developing countries whereas 86% have been carried out in developed economies [12]. This study investigates aspects of LM and SMEs in the context of the Kurdistan Region of Iraq (KRI).

KRI is a federal territory located in the North of Iraq, an area where manufacturing SMEs play a significant role in domestic and regional markets and are considered as a major contributor to the region's economic development. As a non-oil sector, as evidenced in [13], statistically the SMEs comprise 95.8% of the KRI's companies, employ 78.3% of the labour force and share 41% of the total revenue of the industrial sector.

In spite of the aforementioned attractive significance of the manufacturing sector in the KRI, no studies on lean practices have been carried out. Consequently, the need for such empirical studies that investigate the influence of lean practices on business performance is timely. This paper, therefore, provides a better understanding of the lean strategies and their effects on leadership, process management, strategic planning, continuous improvement, customer relationship, employee satisfaction and organisational learning. In addition, it attempts to see the impacts associated with customer satisfaction, business profitability, employee satisfaction, competitiveness growth and ergonomic improvement.

To tackle the above objectives, the study highlights two main questions:

Q1: Does LM have a relationship with SMEs business performance?

Q2: Which lean practice has the greatest impact on SMEs business performance?

The rest of this study is structured in seven sections. The first section presents a review of LM literature in the context of developing countries and manufacturing SMEs. In section two, the development of the measurement instrument and critical areas of LM are illustrated. The next section explains the conceptual framework and the hypothesis development. The methodology and the statistical results are discussed in section four and five. Interpretation of the findings is provided in section six. Finally, the limitation of the study, direction for further research and the conclusions are presented in section seven.

2. Literature Review

LM is a practice-based manufacturing paradigm that emphasises on eliminating waste, assures harmonic material and information flow, and constantly attempts to reach perfection [14]. Originally, it traces back to the shop-floors

of Toyota Motor Corporation in the 1960s where it was known as Just-In-Time (JIT) or Toyota Production System (TPS) [15]. After that, the term 'lean' was introduced by Karfick in 1988 and disseminated by Womack *et al.* [16] to describe a manufacturing system that eliminates wastes and improves customer satisfaction [17]. LM aims to improve quality, increase efficiency, reduce human efforts, eliminate errors and problems, shrink inventory, simplify and visualise management, involve all employees, speed up production, decrease manufacturing cost and develop work conditions [18].

Belekoukias *et al.* [19] empirically studied 140 manufacturing firms around the world to prove that JIT, Autonomation, Kaizen, Total Productivity Maintenance (TPM), and Value Stream Mapping (VSM) practice has significant effects on cost, speed, quality and flexibility of operational performance.

Many developing countries such as Malaysia, Pakistan, Thailand, India and Indonesia have been involved in implementing LM initiatives for more than a decade [20, 21]. Forrester *et al.* [22] empirically examined 37 agricultural machinery enterprises in Brazil and claimed that LM adoption presents a potential long-term advantage over competitors, especially in craft-based industries in developing countries.

Due to resource limitation, size and organisational structure of SMEs, Shah and Ward, 2003; Cooney, 2002; Fullerton and McWatters, 2001; Golicic & Medland, 2011; Axelson, 2007 [23, 24, 25, 26, 27] argued that full LM practices are more likely to be implemented in big businesses rather than SMEs. In some circumstances, multi-function employees, complete TQM programmes, and complex technologies might be impossible for SMEs.

Ottar *et al.* [28] claimed that LM initiatives for SMEs need two necessary considerations. First, the enterprise has to be prepared, understood and trained about the lean concepts, principles and requirements. Second, the proposed framework has to be tailored to the needs and nature of the company.

3. Measurement Development

The LM literature argued that there is no standard framework for successful LM implementation [29, 30, 31]. Understanding LM Critical Success Factors (CSF) could help the companies to recognise their exact needs and readiness to begin their LM journey.

The most highlighted CSF in the literature are; top management commitment, human resource management, continuous improvement, strategic planning and internal process improvement [12, 32, 33, 34, 35, 36,]. Factors such as; visual management, deep understanding of LM principles [37], risk management [38], internal competence and appraisal system [28], quality improvement and housekeeping [30], product design and supplier development [40], managing culture change, infrastructure and reward system [41] are also highlighted.

To measure the LM practices in KRI's manufacturing SMEs, this study will emphasise on seven CSF. Table 1 presents the meaning of LM measures and the relevant literature whose they have been applied. Concurrently, five indicators were applied to measure the business performance in the studied SMEs. Table 2 illustrates the meaning of each indicator and their relevant literature.

Table 1. LM practice meaning and measurement in the KRI's SMEs

No.	LM measures	Meaning	Measurements Dimensions	Authors
1	Lean leadership	High ability to motivate the best LM performance throughout the factory.	LI1: long-term thinking LI2: reward and motivation LI3: full commitment LI4: problem-solving skills LI5: personal involvement CR1: survey customer needs	7, 9, 11, 12, 32, 33, 34, 35, 36, 38, 40, 43, 44.
2	Customer relationship	The ideal relationship that helps the company to understand the needs of clients and evaluate their behaviour to ensure quick and efficient responses to required goods or services at the competitive price.	CR2: wide-market products at competitive prices CR3: quick feedback responsiveness CR4: resource availability CR5: competitive position understanding PM1: lead time reduction	8, 34, 35, 36, 39, 45.
3	Process management	Simple, systematic and standardised production procedures which guarantee the easiest way to complete the production with highest possible quality and lowest cost and wastes.	PM2: automated production technologies PM3: necessary preventive maintenance programme. PM4: waste elimination PM5: statistical process control	8, 32, 34, 35, 36, 39, 40, 43.
4	Strategic planning	Broadly systematic envision intended at creating lean enterprise, making decisions on allocating resources and controlling manufacturing processes to pursue this target	SP1: Clear lean strategies SP2: smart relative goals SP3: relevant production activities SP4: regular review of the strategies SP5: delegated responsibilities CI1: quality source analysis	11, 28, 30, 32, 34, 36, 37, 38, 40, 44.
5	Continuous improvement	Systematic, incremental improvements of manufacturing processes through corporate involvement and responsibilities.	CI2: flow of information CI3: continuous evaluation system CI4: supplier network development CI5: open-door policy HRD1: workload balancing	1, 8, 9, 11, 12, 32, 33, 34, 35, 36, 38, 41, 42, 43.
6	Human resource development	Conditions of trust, respect, secure, safe and development in the production operation to enhance efficiency and productivity.	HRD2: cross-functional training HRD3: total employees involvement HRD4: workforce empowerment HRD5: team-working cells OL1: proper system for data collection	8, 9, 11, 12, 28, 30, 32, 33, 34, 35, 36, 39, 40, 43, 46.
7	Organisational learning	Establishment of robust knowledge ground to improve lean workforce awareness and to provide required information of each particular phase of the production system.	OL2: consultation advice seeking OL3: Strong network with similar LM businesses OL4: benchmarking OL5: communication and knowledge sharing	9, 12, 30, 32, 33, 34, 35, 36, 38, 40, 43, 44.

4. Research framework and hypotheses development

The research framework is a conceptual diagram representing the relationship of LM practices with firm performance. It claimed that higher level of business performance theoretically depends on the degree of lean practices. Since this study was conducted in the KRI's manufacturing SMEs to explore the mentioned link, the

hypotheses, therefore, can be articulated as follows:

H1 Lean practices have a significant impact on the company's business performance.

So, the hypothesis of the lean practices indicators can be presented as below:

H1LE: Leadership has a positive relationship with business performance.

H1CR: Customer relationship has a positive correlation with business performance.

H1PM: Process management has a positive correlation with business performance.

H1SP: Strategic planning has a positive relationship with business performance.

H1CI: Continuous Improvement has a positive relationship with business performance.

H1HRD: Human Resource development has a positive correlation with business performance.

H1OL: Organisational learning has a positive relationship with business performance.

Table 2. Business performance indicators.

No.	Indicator	Meaning	Author
1	BP1: Customer satisfaction	The level to which the products of the company satisfy or exceed the client's expectation.	42, 46, 47, 48, 50, 51.
2	BP2: Profitability increases	The condition in which the business is earning a profit or financial gain.	45,46, 48, 49, 50, 51, 52, 53, 54.
3	BP3: Employee satisfaction	The situation in which employees are happy, contented and satisfying their desires and needs with their job and position.	49, 48, 50, 51, 54.
4	BP4: Competitiveness growth	The ability to provide products that meet the quality standards to the markets at competitive prices with adequate returns on the resources employed.	9, 45, 54.
5	BP5: Ergonomics improvement	The process of removing risk factors that hamper high performance and productivity.	45, 49, 52, 54.

5. Methodology

This survey was conducted from July to October 2016 in manufacturing SMEs. The participating companies were selected randomly from a list provided by the KRI Industrial and Commerce Chamber in 2013. The sample was limited to private manufacturing SMEs, excluding government controlled and public enterprises. The current study was confined to three managerial levels including owner-managers, authorised directors and production managers. The data collection instrument was a self-administered structured survey questionnaire which was appropriately designed to cover all aspects of LM practices which were weighted on the five-point Likert scale: 1 for poor, 2 for below average; 3 for average; 4 for more than average and 5 for superior implementation.

To achieve a fair level of representation, the selected factories covered different industrial sectors. In total, the survey sampled 350 enterprises representing approximately 10% of the entire population of the sectors in the KRI. 219 of them (62.5%) agreed to participate in the study. In the end, 207 usable forms representing a response rate of

(94.5%) were returned and analysed for further findings. The sample essentially covers four types of manufacturing sector including construction materials, metal treatment, plastic, food and drink. Table 3 shows a summary of the case companies profile in the KRI.

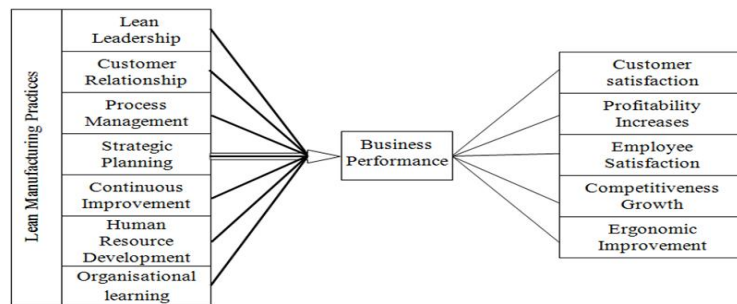


Fig.1. Conceptual framework: relationship between LM practices and Business Performance.

Table 3. Summary of companies Profile

	Frequency	Percent		Frequency	Percent
Main type of industry			Age of the company		
Food and Drinks	19	9.2	Less than five years	63	30.4
Textile	8	3.9	From five to ten years	100	48.3
Plastic	31	15.0	More than ten years	44	21.3
Wood processing Industries	8	3.9	Total	207	100
Construction materials manufacturing	66	31.8	Full-time employees		
Printing	1	0.5	1 - 4	20	9.7
Petrochemical	1	0.5	5 – 15	110	53.1
Metal processing	55	26.5	16 - 50	77	37.2
Machinery	7	3.4	Total	207	100
No - metallic product	3	1.4	Ownership		
Petroleum products	8	3.9	Private	186	89.8
Total	207	100	Partnership	13	6.3
			Part of other company	8	3.9
			Total	207	100

6. Results

6.1 Components Factor Analysis (CFA):

To avoid multicollinearity among proposed LM practice elements, a varimax rotated Principal Component Factor Analysis (PCFA) was applied to the LM and business performance variables. Only a factor loading of 0.5 or higher on the factor and 0.3 or lower on the other factors was considered. The results extracted seven factors, each with an eigenvalue of more than one and jointly explained 66.98% of the total variance. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy value was 0.873 (> 0.6), and Bartlett's Test of Sphericity significant was at 4143.48 for (p -value = 0.000, < 0.01).

As a result of low loading, two sub-elements of LM practices factors (CI2 and OL1) were removed. The other thirty-three items which are unidimensional and hold high factor loading were retained for further analysis. Tables 4 summarises the results of PCFA of the framework

Table 4. Rotated factors and factor loading for LM practices elements

Items	Components Factors						
	1	2	3	4	5	6	7
<u>Lean Leadership</u>							
LI1: long-term thinking	-.151	.111	.790	.009	-.045	.119	.078
LI2: reward and motivation	-.031	.219	.803	.051	-.008	.032	.023
LI3: full commitment	.006	.037	.769	.126	.141	.029	.060
LI4:problem-solving skills	.029	.008	.721	.152	.139	.079	.075
LI5: personal involvement	-.029	.087	.829	.088	.124	.006	.056
<u>Customer relationship</u>							
CR1: survey customer needs	.737	.114	.054	.236	.163	.028	.099
CR2: wide-market products at competitive prices	.888	.077	-.012	.169	.048	.145	.073
CR3: quick feedback responsiveness	.833	.035	-.060	.073	-.029	.195	.143
CR4:resource availability	.872	.091	-.023	.092	.023	.112	-.071
CR5:competitive position understanding	.821	.199	-.150	.083	-.013	.059	-.042
<u>Strategic Planning</u>							
SP1: Clear lean strategies	.219	.805	.128	.250	.130	.037	.043
SP2: smart relative goals	.164	.813	.079	.264	.116	.146	.022
SP3: relevant production activities	.071	.768	.130	.204	.167	.059	.014
SP4: regular review of the strategies	.118	.784	.106	.163	.011	.119	.015
SP5: delegated responsibilities	.002	.825	.073	.097	.225	.049	.101
<u>Process Management</u>							
PM1: lead-time reduction	.209	.173	.100	.768	.117	.105	.160
PM2: automated production technologies	.259	.200	.112	.758	.192	.055	.190
PM3: necessary preventive maintenance programme.	.204	.269	.133	.661	.021	.042	-.053
PM4: waste elimination	.030	.261	.034	.713	.201	.252	.082
PM5:statistical process control	.063	.163	.151	.756	.187	.087	.124
<u>Continuous Improvement</u>							
CI1: quality source analysis	.173	.125	.102	.150	.216	.688	-.020
CI2: flow of information	.051	.053	.148	.029	.403	.666	.178
CI3: continuous evaluation system	.178	.051	.053	.035	.279	.715	.150
CI4: supplier network development	.046	.035	.031	.129	.094	.726	.216
CI5:open-door policy	.131	.126	.007	.100	.167	.783	.034
<u>Human Resources Development</u>							
HRD1: workload balancing	-.022	.021	.013	.092	-.028	.204	.747
HRD2:cross-functional training	.051	.041	.003	.123	.182	.050	.732
HRD3: total employees involvement	.060	-.036	.124	.053	.205	.067	.666
HRD4: workforce empowerment	.039	.048	-.040	.069	.078	.140	.784
HRD5: team-working cells	.036	.079	.192	.028	.051	-.012	.701
<u>Organisational Learning</u>							
OL1: proper system for data collection	.104	.227	.085	.128	.669	.338	.098
OL2: consultation advice seeking	.018	.128	.098	.216	.757	.233	.093
OL3: Strong network with similar LM businesses	.091	.181	.073	.159	.716	.131	.014
OL4: benchmarking	.015	.138	.002	.067	.570	.236	.224
OL5: communication and knowledge sharing	-.029	.018	.136	.099	.743	.164	.158
Eigen Value	9.2	3.8	3.1	2.2	2.1	1.5	1.2
Percentage of variance (66.98%)	26.45	10.9	9	6.53	6	4.5	3.6
P < 0.01							

Similar processes were also applied to the criteria of business performance; customer satisfaction, profitability increases, employee satisfaction, competitiveness growth and ergonomic improvement. The PCFA of the business performance elements resulted in only one factor which has an eigenvalue of 2.63 and explained 52.3% of the total variance. The KMO value was 0.774 (> 0.6), and the significant value of Bartlett's test was 253.6 for a p-value of 0.000 (< 0.01). All items were retained for the next step of the analysis. Table 5 presents the results of the test.

Table 5. Factor loadings for business performance

Items	Component factor
Business Performance	
BP1: Customer satisfaction	.710
BP2: Profitability increases	.652
BP3: Employees satisfaction	.798
BP4: Competitiveness growth	.705
BP5: Ergonomics improvement	.742
Eigen Value	2.63
Percentage of variance (52.3%)	52.3
P < 0.01	

6.2 The reliability test through Cronbach's Alpha

The reliability of the used questionnaire was tested according to Cronbach's α . It shows how closely the instrument elements are related to a group and to what extent they measure the same concept [54]. Table 6 presents the Cronbach's α of the survey. The overall reliability coefficient of the framework's variables is 0.93, and that of individual variables ranging from 0.7 to 0.8 (except customer's relationship: 0.6).

Table 6. Reliability coefficient of the study's variables

Items	Total items	Cronbach α
Business Performance	5	0.7
Lean Leadership	5	0.7
Customer relationship	5	0.6
Strategic Planning	5	0.7
Process Management	5	0.7
Continuous Improve	4	0.8
Human Res Development	4	0.8
Organisational learning	4	0.7

6.3 Pearson's Correlation Analysis

To determine the statistical bivariate relationship among the variables (dependent and independent), Pearson's Correlation analysis was carried out. Table 7 presents the results showing high correlation coefficients ranging from 0.43 to 0.79. Column one in table 7 indicates the correlation between Business Performance and LM practices. The results concluded that Human Resources Development highly correlated to Business Performance (r-value is 0.674, $p < 0.01$), followed by Continuous Improvements (r-value of 0.625, $p < 0.01$). Organisational Learning and Process Management are also highly correlated with Business Performance (r-value of 0.622 and 0.6 respectively, $p < 0.01$).

The other three variables in column one correlated to Business Performance at lower levels. Lean Leadership ($r=0.55$, $p<0.01$); Strategic Planning ($r=0.47$, $p<0.01$) and for Customer's Relationship ($r=0.45$, $p<0.01$).

Table7. Pearson's correlation analysis of the variables

Variables	1	2	3	4	5	6	7	8
1 Business Performance	1							
2 Lean Leadership	.552	1						
3 Customer relationship	.451	.430	1					
4 Strategic Planning	.473	.523	.626	1				
5 Process Management	.603	.582	.588	.696	1			
6 Continuous Improve	.625	.648	.595	.677	.718	1		
7 Human Res Development	.674	.747	.490	.596	.654	.798	1	
8 Organisational learning	.622	.603	.466	.572	.643	.744	.771	1

Correlations are significant at $p<0.01$.

6.4 Multiple regression analysis

To predict the value of business performance based on the level of LM implementation variables, and also to determine how much of its variation can be explained by each element of LM practices, Multiple Regression Analysis was applied to the data. The results of this test will be the empirical response to the research questions and hypotheses previously raised in the context of KRI's manufacturing SMEs. Table 8 presents the results of Multiple Regression Analysis showing that LM practice factors have a considerable impact on business performance.

The coefficient of determination R^2 value accounts for 0.518 meaning that 51.8% of the business performance can be explained by the seven variables of LM implementation. Based on the conceptual framework, Human Resource Development ($\beta=0.334$ at $p<0.01$), Process Management ($\beta=0.224$ at $p<0.01$) and Organisational Learning ($\beta=0.17$ at $p<0.05$) have the most positive significant impacts on business performance. In conclusion hypothesis H1, H1HRD, H1PM and H1OL were supported. In contrast, Lean Leadership ($\beta=0.049$ at $p>0.05$), Customer Relationship ($\beta=0.08$ at $p>0.05$), Strategic Planning ($\beta=-0.092$ at $p>0.05$) and Continuous Improvement ($\beta=0.057$ at $p>0.05$) present non-significant effects on the business performance. Consequently, hypothesis H1LE, H1CR, H1SP and H1CI were rejected. The regression equation of the proposed model could be formalised as follows:

$$\text{Business Performance} = 6.745 + 0.229\text{PM} + 0.264\text{HRD} + 0.125\text{OL}.$$

7. Discussion

The study assessed the effects of seven LM critical factors on five indicators of Business Performance. The results revealed empirical evidence of the significant positive impact of LM practices on the business performance in developing countries. This is supported by previous studies [6, 55, 56, 57, 58, 59]

Human Resource Development confirmed significant and positive correlation with business performance. This proved that implementing LM approach through workload balancing, cross-functional training, total employees involvement, workforce empowerment and encouraging team working culture will lead to high business performance. This supports the conclusions [60, 11].

Process Management was the second determinant of LM practices that significantly and positively correlated with

Business Performance. The performance effects of Process Management have been the subject of previous studies [45, 36, 30, 35].

Organisational Learning was also highly related to Business Performance. This factor establishes a sound foundation for sustained LM practices depending on data collection, cross-communication among all members and networking with similar companies. Consideration of this factor that enhances LM practices was also previously highlighted by other authors [46, 34, 39, 11].

The findings of this study will contribute to knowledge by providing statistical evidence on the LM practices impacts for manufacturing SMEs in developing countries. It will also support the owners/managers and production operators to concentrate on the mentioned successful activities in their companies to improve business performance and survive in the current competitive environment.

Table8. Regressions calculating business performance

	B	Std. Error	β	ρ
Constant	6.745	1.802		.000
Lean Leadership	.043	.066	.049	NS
Customer relationship	.075	.063	.080	NS
Strategic Planning	-.080	.067	-.092	NS
Process Management	.229	.081	.224	<0.01
Continuous Improvement	.047	.080	.057	NS
Human Res Development	.264	.081	.334	<0.01
Organisational Learning	.125	.075	.170	<0.05
R ²	0.518			
Adj. R ² (Adjusted R ²)	0.51			
ρ (Significant value)	< 0.001			
F ratio (Static ratio)	30.5			
N (Number of cases)	207			

Dependent Variable: Business Performance
 B: Parameter Estimates; R²: coefficient of determination.

8. Limitation, further research

The study exposed limitations which were considered during the interpretation of the results and may bring attention to this for further research. First of all, just the internal issues of LM practices were the subject of the study. However, external aspects such as customer and supplier relationship, working environment and government support also influence business performance and might need more consideration. Second, factors such as size, ownership, the age of the company and organisational culture might moderate the correlation between LM practices and business performance. Further research might extend the scope of the conceptual framework of this study. Third, the survey was limited to manufacturing SMEs while big business and other industrial enterprises were excluded.

9. Conclusion

The study empirically investigated the relationship between LM practices and business performance in the KRI's manufacturing SMEs. A conceptual framework comprising seven criteria representing the CSF of LM, and five indicators measuring business performance guided the study. Descriptive statistical analysis, components factor

analysis, reliability test, Pearson's correlation analysis, and Multiple Regression Analysis was employed to investigate the collected data. The result confirmed partial effects of some LM practices on business performance. The findings also provided empirical evidence of LM applicability in the SMEs of developing countries.

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