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What Drives Innovation Performance? A Study of Sri Lankan Software Development Industry

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Abstract

This study investigates the impact of market orientation and R&D and knowledge management practices on innovation performance of Sri Lankan Software Development firms. In this study, market orientation is considered as an antecedent for the overall relationship structure. We also test the roles of management style & leadership and resource support as driving forces of R&D management practices. A conceptual framework is constructed with the support of related literature. Research constructs are operationalized with existing psychometric instruments, which were already validated for their content. A disproportionate stratified random sample of 128 R&D managers and engineers involved in software development is selected from 32 firms, and an online survey is conducted using a structured questionnaire. Results reveal that direct positive effects of R&D and knowledge management practices are statistically significant on the innovation performance of the software development firm. Moreover, knowledge management, management style & leadership and resource support positively affect R&D management practice. Also, the antecedent role of market orientation is evident. Findings of this research provide an empirically validated framework to boost the innovation performance of the Sri Lankan software industry.

Keywords: Innovation performance, R&D management, Sri Lankan Software development industry, Market orientation, Knowledge management

1. Introduction

It is well established that the world is significantly changed by innovations in the software industry and software firms have to constantly innovate just to be in business, let alone thrive in it. However, given the relatively underdeveloped status of the Sri Lankan software industry, there is a need for Sri Lankan software firms to innovate. The Software Development industry in Sri Lanka is thought to be one of the exponentially developing industries and it is ahead or keeping pace with regional and global trends. The Sri Lankan Information Technology – Business Process Management (IT-BPM) Industry Review, PricewaterhouseCoopers (2014), has documented that the global demand for IT/BPM software & services was at USD 1.2 trillion in 2013. There was a 4.5% growth over the demand documented in 2012. Sri Lanka's fortunate geographic location at the southern tip of India positions it at the junction connecting South Asia, Far East, and the Pacific with Europe and America. The global presence is evidence for Sri Lanka's development as a niche destination for Software Product Engineering and Finance Accounting Outsourcing. Developing as a foremost source destination for global IT-BPM services, Sri Lanka is achieving global brand recognition and visibility. Local and foreign investors are now ready to invest in the Sri Lankan Software Development Industry. Competition in the Sri Lankan Software Development Industry has been growing. To maintain their position in an expanding industry, software development companies are innovating. Innovation has been identified as a critical factor for the software development industry (Balasooriya, 2014).

For today's business organizations, creation and exploitation of knowledge have become a competitive advantage. Moreover, global competition has strengthened due to the rapid developments in information technology. Hence, organizations are seeking innovative products, processes, and technologies to win the markets due to this competition. In the era of a knowledge-based economy, the proverb in the software development industry is that "knowledge is power" and it has become competitive in the area of Information Technology. The global competition has strengthened due to the rapid development of information technology. The speed of "go to market" is accelerating at an exceptional rate (Huang and Lin, 2006). R&D activities are critical for an organization when departments of the organization are networked to enhance innovation facilitated by innovation-oriented organizational goals.

The connection between knowledge management and R&D management is characteristically close because the R&D processes can fundamentally be considered as resulting from knowledge management processes. Furthermore, the knowledge required for new product concepts and process designs is generated due to the information transformation on technological advancements and market demands (Park and Kim, 2005). As per Park and Kim (2005), knowledge management system of an R&D organization should be expanded and elaborated over time.

Motivated by the above-mentioned facts on the importance of innovation for the software industry in Sri Lanka as a country, this study investigates whether innovation performance in the Sri Lankan Software Industry is driven by R&D management practices, knowledge management practices, and market orientation of a software development firm. In this study, market orientation is considered as an antecedent for the overall relationship structure. We also test the roles of management style & leadership and resource support as driving forces of R&D management practices. Based on existing literature, a conceptual framework is formed and analyzed using a random sample of 128 responses. A partial least squares structural equation model (PLS-SEM) is used to demonstrate the relationships and to test underlying hypotheses.

This paper comprises of six sections. Following this introduction is a brief synopsis of the literature on innovation performance, R&D management, knowledge management, market orientation and resource support, and management style & leadership. The next section outlines the methodology of the study. The results of the analysis are described next, followed by a section discussing the findings and outlining the implications. The paper is then concluded.

2. Literature review

The software development industry has been characterized as an industry that requires a substantial amount of R&D expenditure. R&D management is defined as the discipline of designing and leading R&D processes, managing R&D organizations, and ensuring a smooth transfer of new know-how and technology to other groups or departments involved in innovation (Roussel et al., 1991). People, not products, are the major assets of innovative companies, and hiring the right people should be their top priority (Gupta and Singhal, 1993). In the product

innovation business, companies need to do whatever they can to attract and retain the talent that is needed to come up with the latest and best products or services (Hagel and Singer, 1999). Hence, the top priority for human resource managers in R&D organizations is the attraction and retention of talent to support product or service growth (Kochanski et al., 2003). Moreover, Lundvall and Nielsen (2007), document that product innovation is a significant factor in competition.

Innovation is a critical instrument for organizations to secure a place in the competitive world of the future (Zhang et al., 2004). Innovation capability is the ability to adequately absorb, allocate, and use skills and knowledge to enhance existing technology, and to realize new products and technology (Cirera et al., 2015; Huang and Lin, 2006; Lall, 1992). Shyu and Chiu (2002), document that innovation is the progression of exercises in the areas of science, technology, organization, finance, and commerce. In order to drive innovation smoothly, R&D expenditure must be the key power in an organization that is involved in R&D activities (Huang and Lin, 2006; MacPherson, 1997; Romijn and Albaladejo, 2002). It helps to sustain and grow R&D functions progressively. Therefore, a sufficient R&D budget needs to be allocated and adequate equipment; facilities and office support should also be provided (Huang and Lin, 2006). Employee benefits and job security have also been identified to directly influence innovation performance (Chang and Chen, 2002). Having considered the significance of the R&D function for the achievement of innovation performance, this study tests the first research hypothesis over the Sri Lankan software industry as follows.

H_1: There is a positive impact of R&D management practices on innovation performance.

Assessing innovation performance is complex, as there is a wide range of determinants and time lags between R&D spending and subsequent performance (Zhang et al., 2004). MacPherson (1997), claims that innovation is the aftereffect of commercialization after a time of effective design, development, and the fruition or proper refinement of a product. Innovation performance can be measured using both qualitative and quantitative approaches. The quantitative measurements are the number of patents, the number of new products, technical or scientific reports (Huang and Lin, 2006; Romijn and Albaladejo, 2002). Szakonyi (1994), documents that another measurement for innovation performance is the degree of novelty of the products. Huang & Lin (2006), document that novelty is only one

factor, which affects the marketability of products. They claim that it is difficult to evaluate the degree of novelty.

The management of knowledge is frequently recognized as a significant forerunner of innovation (Carneiro, 2000). Knowledge management incorporates organizing, sharing and using knowledge in order to create value and achieve competitive advantage for an organization (Ibrahim and Reid, 2009). A well-designed and well-implemented knowledge management system can bring about higher efficiency, higher customer satisfaction, and decreased costs. There are two major types of knowledge namely, tacit knowledge and explicit knowledge. Tacit knowledge is the knowledge that is difficult to transfer to another person by means of written texts or verbalizing while explicit knowledge speaks to a substance that has been captured in some substantial frame, for example, words, audio, or images (Chugh, 2013). By using data of New Zealand firms, Darroch and McNaughton, (2002) explored a knowledge management instrument which involves three components; knowledge acquisition, knowledge dissemination and responsiveness to knowledge are regressed alongside three-component innovation scale which covers the incremental innovation. They demonstrate that knowledge acquisition and responsiveness to knowledge are more vital for innovation than knowledge dissemination. Wang and Ellinger (2011), have further pointed out that the individual-level innovation performance and organizational level innovation performance are the main outcomes of organizational learning which consist of four indicators; information acquisition, information distribution, information interpretation, and organizational memory. More generally, knowledge dissemination and responsiveness to knowledge have been suggested as the most effective dimensions in the creation and maintenance of competitive advantage (Day, 1994; Fahey and Prusak, 1998; Leybourne and Kennedy, 2015). In line with these arguments, this study tests the second and third research hypotheses as follows.

H_2: There is a positive impact of knowledge management practices on innovation performance.

H_3: Knowledge management practices have a positive impact on R&D management practices.

The success of a new product on the market is significantly influenced by marketing activities. Therefore, the innovation performance of R&D teams should

be measured only up to the point at which promising, marketable products are generated. As long as new products or improvements to products are supposed to have market potential, then the R&D team should not be held accountable for whether products are marketed successfully or not (Huang and Lin, 2006). Market orientation is a customer focused way to deal with product design and is a part of the organizational culture that is accepted to have broad impacts on the firm. Information management is defined as the core component, and market orientation is characterized as the organization-wide generation of market knowledge relating to present and future customer needs, dissemination of the knowledge crosswise over divisions, and organization-wide responsiveness to it (Kohli and Jaworski, 1990). Han, Kim, and Srivastava, (1998), examine how the three core components of market orientation (customer orientation, competitor orientation, and inter-functional coordination) affect the two core components of organizational innovativeness, which course to influencing corporate performance. Jiménez-Jimenez et. al. (2008), empirically tested the impact of market orientation, organizational learning, and innovation on performance. They demonstrate that market orientation and organizational learning boost the innovation process. Akman and Yilmaz (2008), investigate the relationships among market orientation, innovation strategy, innovative capability, and innovation success in small and medium-sized business in developing countries. Verhees and Meulenberg (2004), explore the consolidated impact of market orientation and innovativeness of product innovation on company performance in small firms. They pointed out that the proprietor's innovativeness penetrates all factors in the model and affects market orientation, innovation, and performance. Overall, the literature indicates that market orientation of a firm not only leads the innovation performance but also enhances the learning process, leadership, and management involvement in the R&D function. Based on this antecedent role in market orientation, the following research hypotheses are tested in this study of the Sri Lankan software industry.

H_4: There is a positive impact of market orientation on innovation performance.

H_5: Market orientation has a positive impact on R&D management practices.

H_6: Market orientation has a positive impact on knowledge management practices.

H_7: Market orientation positively affects management style and leadership.

On the other hand, an organization requires well-committed leadership and management support in order to create an innovative culture (Maughan, 2012).

Therefore, the qualifications and experience of a manager who gets involved in R&D activities are imperatively significant for innovation performance, however, the criteria that are used to choose potential R&D managers are still biased in favor of the person with the best technical skills (Clarke, 2002). Elkins and Keller (2003), document that transformational project leaders who convey a motivational vision and provide intellectual stimulation and leaders who build up a top-notch leader-member exchange relationship with project members are connected with project achievement. Furthermore, Hamel (2006), indicates that leadership is essentially imperative since innovation in management principles is necessary to facilitate a long-term advantage and create extraordinary shifts in competitive position. Whitelaw (2013), indicates that there are a few differences within and across the three managerial levels in their leadership styles relying on the current objective. These distinctions incorporate the particular sorts of leadership styles embraced, and the number of styles embraced, both within and across the current objective (Whitelaw, 2013). Thus, it is evident that the management style and leadership plays a prominent role not only for facilitating with the resourced to boost resource support for the R&D process but also to directly provide a vision to the firm's R&D function. Accordingly, this study tests the following research hypotheses for the Sri Lankan software industry.

H_8: Management style and leadership of the firm have a positive impact on R&D management practices.

H_9: Resource support provided by firm has a positive impact on R&D management practices.

H_{10}: Management style and leadership positively affect resource support provided by the firm to.

3 Methodology

In line with the literature review and proposed research hypotheses in the previous section, this study conceptualizes the research framework as shown in Figure 1.

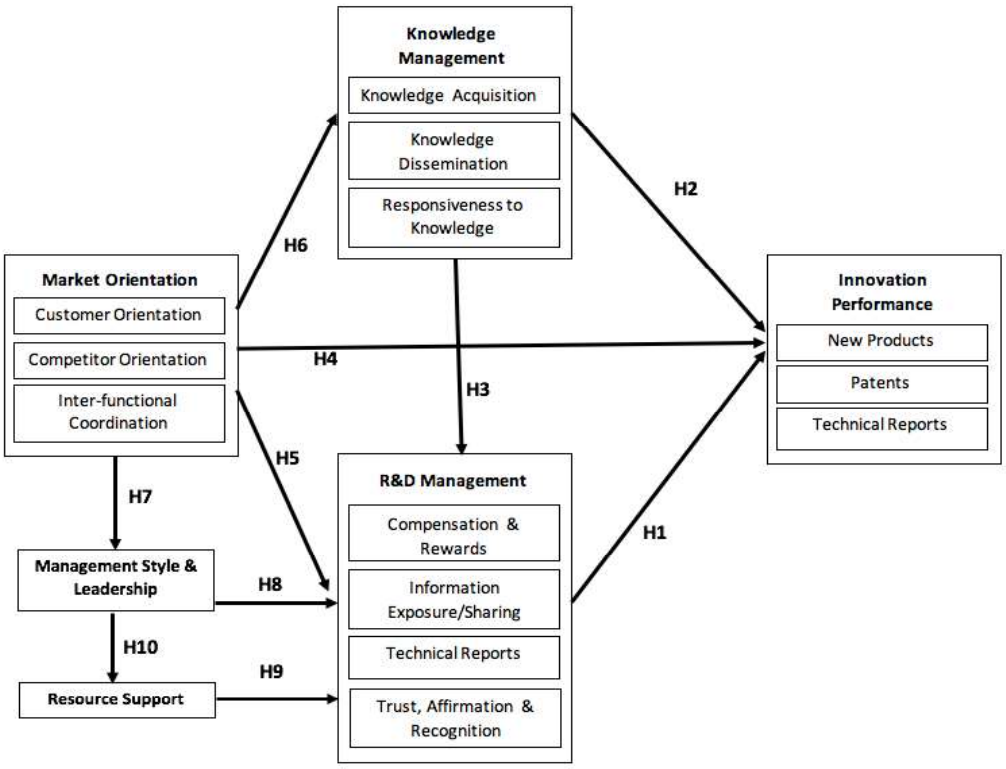

Figure 1. Research Framework

It should be noted that H_1, H_2, and H_4 demonstrate direct effects of R&D management practices, knowledge management practices, and market orientation on innovations performance while H_3 and H_5 indicate an indirect impact of knowledge management practices and market orientation on innovation performance, with R&D management practices mediating the relationships. Moreover, H_6 establishes an indirect effect of market orientation on innovations performance via knowledge management practices, which acts as a mediator. Management style & leadership tend to mediate the relationship between market orientation and R&D management practices in H_7 and H_8 while resource support tends to mediate the relationship between management style & leadership and R&D management practices in H_9 and H_{10}. All these hypotheses are supported by literature reviewed in the previous section.

3.1 Measurements

As illustrated in Figure 1, this study uses six research constructs namely, R&D management practices, knowledge management practices, market orientation, innovation performance, management style & leadership, and resource support. R&D management practices (RDMP) consist of three dimensions namely, compensation & reward (CR), information exposure and sharing (IES), and technical reporting (TR). These dimensions are measured using a 5-point Likert Scale following Huang and Lin (2006). The questions forming the dimensions are presented in Appendix A. Similarly, Knowledge management practices (KM) construct includes three dimensions namely, knowledge acquisition (KA), knowledge dissemination (KD), and responsiveness to knowledge (R2K) which are measured using a 5-point Likert Scale as per Wang and Ellinger (2011) and Darroch and McNaughton (2002). Market orientation (MO) construct also carries three dimensions namely, customer orientation (CUSO), competitor orientation (COM), and inter-functional coordination (IFC) in line with Han, Kim, and Srivastava (1998). These constructs are also measured using a 5-point Likert Scale using the questions presented in Appendix A. Innovation performance (IP) is the dependent variable of the conceptual model, which includes three dimensions namely, new products (NP), patents (PAT), and technical reports (TER). Following Huang and Lin (2006), this study uses a 5-point Likert Scale using the questions shown in Appendix A to measure underlying dimensions of innovation performance even though they could be objectively measured.

Moreover, management style & leadership (MGLS) construct covers three dimensions namely, proactive thinking (PRT), education (EDU), and leadership style (LS) as in Huang and Lin (2006). The same study also introduces resource support (RESS) construct with two dimensions namely, office support (OFS), and R&D budget for equipment and facilities (RDB). This study adopts the same measurement scales as in Huang and Lin (2006).

3.2 Sampling and data collection

The population of the study consisted of Software Development organizations, which perform R&D and innovation activities in the Sri Lankan Software Development Industry. The population is limited to the Colombo geo-location where most of the Software Development companies are located. The foreign

branches of the above organizations are not included in the study and hence, the empirical domain is limited to the Sri Lankan Software Development Industry. As a result, the sampling frame becomes 84 registered organizations of Sri Lanka Association of Software and Service Companies (SLASSCOM). Thirty-two companies are randomly drawn from SLASSCOM representing 38% of the population by employing disproportionate stratified random sampling procedure. In order to minimize the single response bias, four most suitable respondents (e.g., engineers and managers) from the same organization who are involved in innovation and R&D activities are selected and they are contacted via email. Thus, 128 responses are used for the data analysis representing a sample of 32 organizations.

Data are collected using a structured self-administered online questionnaire. A pilot study involving ten respondents was conducted to streamline the questionnaire for its readability and understandability. Certain technical terms have been rephrased as a result of the feedback received from the pilot survey, as certain measurement indicators were not consistent with the Sri Lankan software industry sector[1].

3.3 Data analysis procedures

This study performs an initial investigation of construct validity and reliability of scale measurements although those measurements are retrieved from existing literature. This assures that these measurements suit the context in which this research has been carried out. Construct validity is assured under both convergent and discriminant validity criteria using average variance extracted (AVE) and Fornell-Larcker method respectively (Henseler, Ringle, and Sarstedt, 2014). An AVE value must be 0.5 at least to indicate sufficient convergent validity, meaning that a latent variable is able to explain more than half of its indicators on average. Fornell-Larcker criterion for discriminant validity checks whether the square root value of the AVE of the corresponding construct is greater than those correlations with other constructs (Henseler, Ringle and Sarstedt, 2014). In order to assure the reliability of measurement scales, internal consistency is assessed using Cronbach's alpha. An alpha value greater than 0.7 indicates reliability of a set of measures. Due to Cronbach alpha's limitations in the population (Hair et al., 2014),

1 Results of the pilot survey are not reported to conserve the space but available upon request.

composite reliability measure is also used to assure the internal consistency with the same threshold level.

This study uses partial least squares structural equation modeling (PLS-SEM) approach for testing research hypotheses. PLS-SEM method is used against covariance-based structural equation modeling (CB-SEM) as PLS-SEM provides more robust results in the presence of relatively small samples, and for the data, which deviate from multivariate normality (Hair et al., 2011). Thus, the conceptual framework is assessed for its significance and relevance using the coefficient of determination (R^2), and the effect size (f^2). All the computations are performed using SmartPLS 3.0 software with 5000 bootstrapped samples.

4. Results

This section explains the results of the study, including the description of the sample, validity & reliability tests, and the estimation of structural.

4.1 Description of the sample

Table 1 illustrates the frequency distributions for the characteristics of respondents and firms included in the surveyed sample. Panel A of Table 1 presents respondents' profiles and Panel B presents firm profiles. It is evident from Panel A that the majority of the respondents are males (78.9%) which is a common phenomenon in the software development industry in Sri Lanka. Moreover, 65% of the respondents are below 31 years of age.

Table 1: Sample Profile

Panel A: Respondents' profile			**Panel B: Firm profile**		
	Frequency	Percentage		Frequency	Percentage
Gender			**No of employees**		
Male	101	78.9	Less than 200	10	31.2
Female	27	21.1	200-500	11	34.3
			Greater than 500	11	34.3
Age group					
Below 25 years	19	14.8	**Age of company**		

25-30 years	64	50.0	Less than 3 years	13	40.6
31-35 years	33	25.8	3-6 years	11	34.3
Above 35 years	12	9.4	More than 6 years	8	25.0
Educational level			**Global Presence**		
Graduate	91	71.1	Yes	30	93.8
Postgraduate Diploma	13	10.1	No	2	6.1
Masters Degree	24	18.8			
Working experience					
Less than 3 years	72	56.2			
3-5 years	38	29.7			
More than 5 years	18	14.1			

Source: Survey Data

As far as educational qualifications are concerned, it is evident that the majority is with graduate level qualifications (71.1%). Also, a majority (56.2%) of the respondents are with less than three years of experience. According to Panel B in Table 1, 65.5% of the companies are up to 500 employees in size, and 74.9% of the companies are up to 6 years old. Furthermore, only 6.1% of the companies are limited to the local market while all other companies are multi-national. This is inevitable as the software industry standards, products, and policies are global than local.

4.2 Validity and reliability of research constructs

Prior to estimating the structural model in Figure 1, confirmatory factor analysis and reliability analysis are conducted to verify the measurement model. All the other indicators used in the model depicted adequate convergence to the underlying constructs. Finalized results of the validity and reliability analysis are illustrated in Table 2. It is evident from Table 2 that the sample adequacy (KMO > 0.5) and significance of the inter-item correlations in the indicator measures (Bartlett's test

p-value < 0.05) exist. Minimum factor loadings presented in Table 2 verify that all factor loadings are greater than 0.7 indicating a satisfactory indicator convergence into underlying constructs. All AVE values presented in Table 2, which are located in the diagonal of the matrix, are also greater than 0.5 indicating that more than 50% of the variation in the underlying indicators are explained by the corresponding construct. Thus, convergence validity is justified.

Table 2 also illustrates Fornell-Larcker criterion for the discriminant validity, AVE of a construct should be greater than the squared correlation values with other constructs (Henseler, Ringle and Sarstedt, 2014). This criterion is fulfilled in Table 2 and hence, discriminant validity is justified. Reliability of the research constructs is assured using internal consistency in measures, which is assessed using both Cronbach's alpha and composite reliability. It is evident from the last two columns in Table 2 that all reliability measures are greater than 0.7 and therefore, it can be stated that an adequate level of internal consistency exists in all constructs.

Table 2: Validity and Reliability Analysis

	Confirmatory Factor Analysis				Squared Correlations (AVE)						Reliability Analysis	
	KMO Statistic	*Bartlett's Chi-square (p-value)*	*Min. Loading*	*Max. Loading*	*IP*	*RDMP*	*KM*	*MO*	*MGLS*	*RESS*	*Cronbach's Alpha*	*Composite Reliability*
Innovation Performance (IP)	0.739	196.0 (<0.001)	0.870	0.909	(0.895)						0.877	0.924
R&D Management Practice (RDMP)	0.759	279.3 (<0.001)	0.700	0.922	0.645	(0.842)					0.861	0.906
Knowledge Management (KM)	0.715	261.7 (<0.001)	0.890	0.950	0.646	0.728	(0.918)				0.906	0.941
Market Orientation (MO)	0.716	185.2 (<0.001)	0.844	0.906	0.643	0.576	0.800	(0.886)			0.862	0.916
Management Style & Leadership (MGLS)	0.683	141.9 (<0.001)	0.744	0.917	0.670	0.657	0.756	0.778	(0.853)		0.815	0.889
Resources Support (RESS)	0.500	123.9 (<0.001)	0.940	0.953	0.763	0.637	0.763	0.689	0.689	(0.946)	0.884	0.945

Source: Survey Data

4.3 Estimation of structural relationships

The fitted SEM using SmartPLS 3.0 is illustrated in Figure 2 along with its standardized coefficients of all direct effects. Values within construct symbols represent adjusted R-square values of corresponding endogenous variables. Table 3 illustrates the statistical significance of all coefficients including direct, indirect, and total effects. Table 3 also presents the effect size of each direct effect using f^2 statistics.

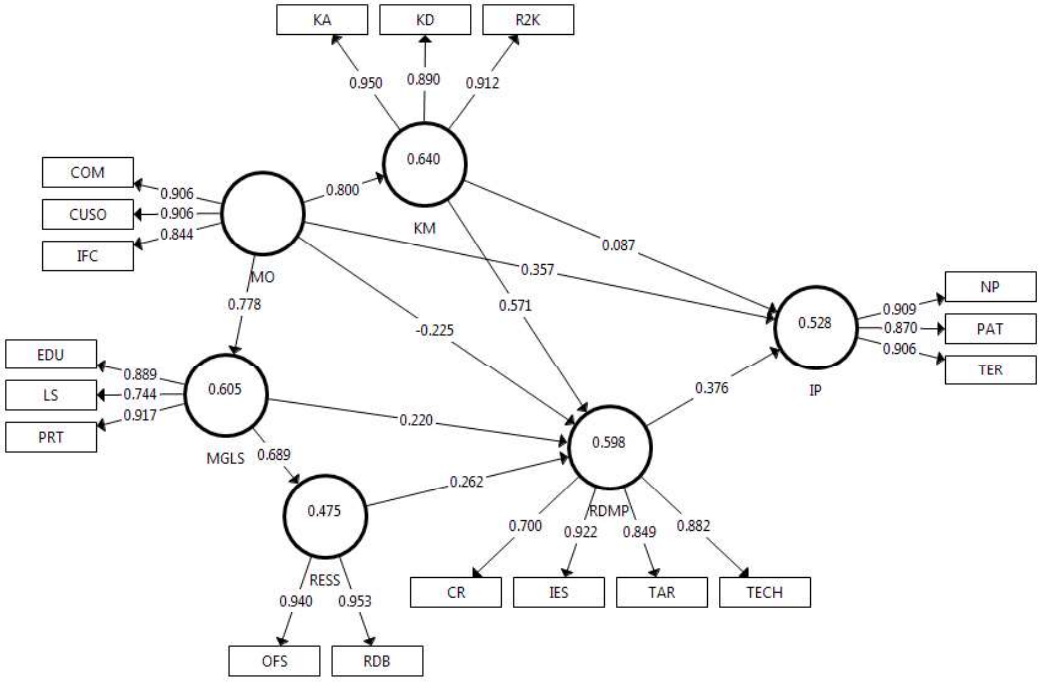

Figure 2: Fitted PLS-SEM

According to Figure 2, R&D management practices, knowledge management practices, and market orientation are positively related to innovations performance. However, direct relationships in Table 3 indicate that the direct impact of

knowledge management is not significant at 5% level. Thus, H_1 and H_4 are accepted but not H_2. Nevertheless, knowledge management is indirectly related to innovations performance mediated by R&D management practices. Hence H3 is accepted along with H_1. According to f^2 values, R&D management practices provide the highest effect (0.14) indicating its dominance as a factor affecting innovations performance.

Market orientation is not significantly related to R&D management practices at 5% level and thus H_5 is not accepted. However, Market orientation is significantly related to knowledge management practices, and management style & leadership supporting H_6 and H_7 respectively at 5% level. Thus, the antecedent role of market orientation is evident except on R&D management.

Table 3: Results of the Fitted SEM

Direct effects	**Coefficient**	**Std.Error**	**t-Stat**	**p-value**	**Effect size (f^2)**	**Decisions on Hypotheses at $\alpha = 0.05$**
RDMP → IP	0.376	0.099	3.804	< 0.001	0.140	H_1: Accepted
KM → IP	0.087	0.137	0.635	0.526	0.004	H_2: Rejected
KM → RDMP	0.571	0.139	4.120	< 0.001	0.248	H_3: Accepted
MO → IP	0.357	0.105	3.397	< 0.001	0.097	H_4: Accepted
MO → RDMP	-0.225	0.121	1.865	0.062	0.036	H_5: Rejected
MO → KM	0.800	0.054	14.761	<0.001	1.775	H_6: Accepted
MO → MGLS	0.778	0.039	19.810	<0.001	1.532	H_7: Accepted
MGLS → RDMP	0.220	0.115	1.907	0.057	0.038	H_8: Rejected
RESS → RDMP	0.262	0.085	3.068	0.002	0.080	H_9: Accepted
MGLS → RESS	0.689	0.050	13.716	<0.001	0.906	H_{10}: Accepted

Indirect effects on IP				
KM → IP	0.214	0.075	2.864	0.004
MO → IP	0.274	0.101	2.702	0.007
MGLS → IP	0.150	0.059	2.529	0.011
RESS → IP	0.098	0.051	1.913	0.056

Total effects on IP				
RDMP → IP	0.376	0.099	3.804	< 0.001
KM → IP	0.302	0.104	2.891	0.004
MO → IP	0.631	0.053	11.809	< 0.001
MGLS → IP	0.150	0.059	2.529	0.011
RESS → IP	0.098	0.051	1.913	0.056

Source: Survey Data

According to the effect sizes in Table 3, market orientation shows the highest effect on knowledge management (f^2 = 1.8) and then on management style & leadership (f^2 = 1.5). It is also evident from the direct relationships in Table 3 that management style & leadership does not affect R&D management practices, but resource support does at 5% level. This leads to reject H_8 but accept H_9. Management style & leadership impact increased resource support significantly at 5% and thus, H_{10} is also accepted. Table 3 also illustrates the total effects on innovation performance. It is evident that all total effects excluding resource support are significant at 5%.

Overall, tested relationships in Figure 2 provide evidence for direct or indirect effects from R&D management practices, knowledge management practices, and market orientation on innovation performance of the software industry, which are significant at 5% level supported by the results in Table 3. Moreover, R&D management practices are influenced by knowledge management practices as well as resource support. Resource support is led by management style and leadership while market orientation drives the firm's management style and leadership.

5. Discussion and implications

This study documents that in-house R&D is a significant determinant of becoming an innovator, but only if the R&D is formalized in some way. Huang and Lin (2006) documents that the relationship between R&D management practice and innovation performance is contingent upon whether there is a formal R&D budgeting procedure, whether there is adequate and timely equipment support, and whether the facility for R&D is well planned, specifically for the team. This study assessed the effect of environmental facilities (information sharing and technical reporting) and incentives & encouragement (compensation, rewards, trust, affirmation, and recognition) towards R&D on innovation performance. Results of this study clearly demonstrate the direct impact of the management of R&D on better innovation performance.

Knowledge acquisition, knowledge dissemination, and responsiveness to knowledge are beneficial for innovation outcomes of the firm that share more knowledge externally also benefit from improved relative innovation performance (Ritala et al., 2015). Alegre (2011) documents that such knowledge management practice can enhance sustained competitive advantages in innovation performance in biotech enterprises, but it does so indirectly through the creation of knowledge

management dynamic capabilities. This study also identifies that the impact of knowledge management practices on firm's innovations performance does not appear directly but indirectly. Results of this study clearly demonstrate that knowledge management practices help to improve R&D management leading to better innovation performance. Thus, the management of software development industry must establish a mechanism for knowledge acquisition, knowledge dissemination, and responsiveness to knowledge if they intend to plan R&D for innovations.

Farrell (2000) argues that market-oriented firms are effective in producing knowledge, where this culture of knowledge production inevitably leads to knowledge–questioning values. Mahmoud et. al. (2016) document that market orientation is positively related to a learning orientation. This study also supports the hypothesis that market orientation leads to knowledge management practices. However, this study does not find a direct relationship between market orientation and R&D management practices. Instead, an indirect relationship was evident through knowledge management and management style & leadership. Moreover, this study found that management style and leadership to achieve the intended objectives of the R&D management process should follow resource support. Ultimately, the antecedent role of market orientation is evident in the process of managing a software development firm towards better innovation performance.

For managers who are involved in R&D activities, and upper or middle management of the organization, the results of this study provide a better understanding of how their leadership style, education background, and expertise will influence the innovation performance through R&D management practices, knowledge management practices, and market orientation. The management of the organization and R&D managers should consider providing adequate resource support (R&D budget, equipment & facilities, office support) for R&D activities and create more value for the innovation performance because none of the direct relationships are significant without resource support. Overall, this study would be an ideal stepping stone for a new framework for a better level of innovation performance in the software industry, with a strategic focus on R&D management, knowledge management, and market orientation.

6. Conclusion

This study combines knowledge from three areas related to the software development industry, namely, R&D management, knowledge management and market orientation to understand the drivers of innovation performance in the software development industry in Sri Lanka. The study makes several contributions. First, this study introduces an extended framework for enhancing innovation performance in the presence of R&D management practices, knowledge management practices, and market orientation. Secondly, this study examines the innovation performance of the Sri Lankan software industry for the first time. Thirdly, relationships revealed in this study help the management of the software development firms not only in Sri Lanka but also in other developing countries to organize their resources and stimulate the management process to boost innovation performance.

The theoretical scope of this paper is limited to R&D management practices, knowledge management practices, market orientation, and innovation performance. Thus, this study incorporates only five research constructs: R&D management practices, knowledge management practices, market orientation, management style & leadership, and resource support. A survey based empirical study is carried out representing the Colombo District where the majority of the firms are located to test the proposed conceptual framework. A PLS-SEM is employed to test the underlying relationships. Results reveal the direct positive effects of R&D management practices, market orientation, and knowledge management practices on innovation performance. Moreover, knowledge management, management style & leadership, and resource support positively influence R&D management practices. Ultimately, market orientation plays an antecedent role in managing software development firms towards innovation performance.

This study opens several promising paths for future research where R&D and innovation are prominent in practice. The focus of this research is the Software Development industry in Sri Lanka. However, there is relevance toany industry in terms of sustainability and competitive advantage and hence, the conceptual model used in this study can be tested for many industries apart from the software development industry. This study uses the number of new products, the number of patents and the number of technical reports published to measure innovation

performance. In future research, the measurement scale of innovation performance can be improved further by incorporating dimensions such as the percentage of sales created by less than two-year-old product designs, percentages of sales generated by intellectual properties, etc. Finally, the learning orientation of the organization would be an important construct to be merged with or replaced by the market orientation construct in the model proposed in this study (Baker & Sinkula, 2002).

References

Akman, G. and Yilmaz, C. (2008). Innovative Capability, Innovation Strategy And Market Orientation: An Empirical Analysis In Turkish Software Industry. *International Journal of Innovation Management*, 12(1), pp.69-111.

Alegre, J., Sengupta, K. and Lapiedra, R. (2013). Knowledge Management and Innovation Performance In A High-Tech Smes Industry. *International Small Business Journal*, *31*(4), pp.454-470.

Baker, W. and Sinkula, J. (2002). Market Orientation, Learning Orientation and Product Innovation: Delving into the Organization's Black Box. *Journal of Market-Focused Management*, *5*(1), pp.5-23.

Balasooriya, B. (2014). *Analysis of Barriers for Innovations in Sri Lankan Software Organizations*. Master thesis. University of Moratuwa.

Carneiro, A. (2000). How Does Knowledge Management Influence Innovation and Competitiveness?. *Journal of Knowledge Management*, *4*(2), pp.87-98.

Chang, P. and Chen, W. (2002). The Effect Of Human Resource Management Practices on Firm Performance: Empirical Evidence From High-Tech Firms In Taiwan. *International Journal Of Management*, *19*(4), pp.622–631.

Chugh, R. (2013). Workplace Dimensions: Tacit Knowledge Sharing in Universities. *Journal of Advanced Management Science, 1*(1), pp.24-28.

Cirera, X., Marin, A. and Markwald, R. (2015). Explaining Export Diversification Through Firm Innovation Decisions: The Case Of Brazil. *Research Policy*, 44(10), pp.1962-1973.

Clarke, T. (2002). One Point of View: Why Do We Still Not Apply What We Know About Managing R&D Personnel?. *Research-Technology Management*, 45(2), pp.9-11.

Darroch, J. and McNaughton, R. (2002). Examining The Link Between Knowledge Management Practices and Types Of Innovation. *Journal of Intellectual Capital*, *3*(3), pp.210-222.

Day, G. (1994). The Capabilities of Market-Driven Organizations. *Journal of Marketing, 58*(4), p.37.

Elkins, T. and Keller, R. (2003). Leadership In Research and Development Organizations: A Literature Review and Conceptual Framework. *The Leadership Quarterly*, 14(4-5), pp.587-606.

Fahey, L. and Prusak, L. (1998). The Eleven Deadliest Sins of Knowledge Management. *California Management Review*, 40(3), pp.265-276.

Farrell, M. (2000). Developing a Market-Oriented Learning Organisation. *Australian Journal of Management, 25*(2), pp.201-222.

Gupta, A. and Singhal, A. (1993). Managing Human Resources for Innovation and Creativity. *Research-Technology Management*, 36(3), pp.41-48.

Hagel, J. and Singer, M. (1999). Unbundling the Corporation. *Harvard Business Review*, [online] (MARCH–APRIL 1999), p.135. Available at: https://hbr.org/1999/03/unbundling-the-corporation [Accessed 21 May 2017].

Hair, J., Ringle, C. and Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. *The Journal of Marketing Theory and Practice, 19*(2), pp.139-152.

Hamel, G. (2006). The Why, What, and How of Management Innovation. *Harvard Business Review*, [online] (FEBRUARY 2006), pp.72–84. Available at: https://hbr.org/2006/02/the-why-what-and-how-of-management-innovation [Accessed 21 Apr. 2017].

Han, J., Kim, N. and Srivastava, R. (1998). Market Orientation and Organizational Performance: Is Innovation a Missing Link?. *Journal of Marketing*, *62*(4), p.30.

Henseler, J., Ringle, C. and Sarstedt, M. (2014). A New Criterion for Assessing Discriminant Validity in Variance-Based Structural Equation

Modeling. *Journal of The Academy Of Marketing Science*, *43*(1), pp.115-135.

Huang, E. and Lin, S. (2006). How R&D Management Practice Affects Innovation Performance. *Industrial Management & Data Systems*, *106*(7), pp.966-996.

Ibrahim, F. and Reid, V. (2009). What is the Value of Knowledge Management Practices?. *Electronic Journal of Knowledge Management, 7*(5), pp.567–574.

Jiménez-Jimenez, D., Sanz Valle, R. and Hernandez-Espallardo, M. (2008). Fostering Innovation. *European Journal of Innovation Management*, *11*(3), pp.389-412.

Kochanski, J., Mastropolo, P. and Ledford, G. (2003). The Human Side: People Solutions for R&D. *Research-Technology Management*, *46*(1), pp.59-61.

Kohli, A. and Jaworski, B. (1990). Market Orientation: The Construct, Research Propositions, and Managerial Implications. *Journal of Marketing*, *54*(2), p.1.

Lall, S. (1992). Technological Capabilities and Industrialization. *World Development*, *20(*2), pp.165-186.

Leybourne, S. and Kennedy, M. (2015). Learning to Improvise, or Improvising to Learn: Knowledge Generation and 'Innovative Practice' in Project Environments. *Knowledge and Process Management*, *22*(1), pp.1-10.

Lundvall, B. and Nielsen, P. (2007). Knowledge management and innovation performance. *International Journal of Manpower*, *28*(3/4), pp.207–223.

MacPherson, A. (1997). The Role Of External Technical Support In The Innovation Performance of Scientific Instruments Firms: Empirical Evidence From New York State. *Technovation*, 17(3), pp.141-151.

Mahmoud, M., Blankson, C., Owusu-Frimpong, N. and Nwankwo, S. (2016). Market Orientation, Learning Orientation and Business Performance. *International Journal of Bank Marketing,* 34(5), pp.623-648.

Maughan, C. (2012). *Organisational Innovation: A Review Of The Literature*. [online] Ninti One Limited. Available at: https://www.nintione.com.au/?p=4985 [Accessed 18 Jan. 2017].

Park, Y. and Kim, S. (2005). Linkage between knowledge management and R&D management. *Journal of Knowledge Management*, *9*(4), pp.34-44.

PricewaterhouseCoopers (2014). *Sri Lankan IT/BPM Industry 2014 Review*. [online] SLASSCOM. Available at: https://slasscom.lk/sites/default/files/Sri%20Lankan%20IT-BPM%20Industry%20Review%202014.pdf [Accessed 13 Feb. 2016].

Ritala, P., Olander, H., Michailova, S. and Husted, K. (2015). Knowledge Sharing, Knowledge Leaking and Relative Innovation Performance: An Empirical Study. *Technovation*, 35, pp.22-31.

Romijn, H. and Albaladejo, M. (2002). Determinants of Innovation Capability In Small Electronics and Software Firms in Southeast England. *Research Policy*, 31(7), pp.1053-1067.

Roussel, P., Saad, K. and Erickson, T. (1991). *Third Generation R & D: Managing the Link to Corporate Strategy*. 1st ed. Harvard Business Review Press.

Shyu, J. and Chiu, Y. (2002). Innovation Policy for Developing Taiwan's Competitive Advantages. *R and D Management*, 32(4), pp.369-374.

Szakonyi, R. (1994). Measuring R&D Effectiveness—I. *Research-Technology Management*, 37(2), pp.27-32.

Tether, B. (2002). Who Co-operates For Innovation, and Why. *Research Policy*, 31(6), pp.947-967.

Verhees, F. and Meulenberg, M. (2004). Market Orientation, Innovativeness, Product Innovation, and Performance in Small Firms. *Journal of Small Business Management*, 42(2), pp.134–154.

Wang, Y. and Ellinger, A. (2011). Organizational Learning. *International Journal of Manpower*, 32(5/6), pp.512-536.

Whitelaw, P. (2013). Leadership up the ladder: The construction of leadership styles in the hospitality industry. *Journal of Contemporary Issues in Business and Government*, 19(1), p.65.

Zhang, Q., Lim, J. and Cao, M. (2004). Innovation-Driven Learning in New Product Development: A Conceptual Model. *Industrial Management & Data Systems*, 104(3), pp.252-261.