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The Impact of Market Orientation and Diffusion on Commercial Success of Patented Innovation in Sri Lanka

Romaine Ferdinands [α], Halinah Binti Atan [σ], Ferdous Azam [ρ] & Ali Khatibi [ω]

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Findings: The study reveals that both market orientation and diffusion have a significant positive impact on the success of patent commercialisation. The results also indicate that patent ownership moderates the relationship of both market orientation and diffusion on commercial success.

Originality: Comparative studies combining different ownership groups in a wide range of industries are scarce and this study contributes to furthering this knowledge. The study also contributes to an area with limited literature by studying innovation diffusion based on the characteristics of the innovation.

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I. Introduction

Innovation plays a vital role in the performance and growth of organisations and countries and is one of the fundamental premises of economic development (Cohen & Levinthal, 1990; Han, 2017). An innovation adds economic benefit only when it is commercialised. Therefore, commercialisation is seen as a vital component in stimulating economic growth and a critical stage in the entire innovation development process (Schilling & Phelps, 2007). This relationship between innovation and economic value generation was cited by the economist Robert Solow (1957) and Schumpeter (1934). Schumpeter proposed that the more significant or radical the innovation was, the greater its impact, resulting in higher economic return. On the other hand, the effect would be marginal with a lesser economic return if the innovation is incremental. Innovation is also noted to have a snowballing effect that generates knowledge that when it gets diffused it generates more knowledge through its application in newer forms of products and processors as the diffusion of the innovation spreads to different industries.

Many developing countries with little R&D budgets bring forth limited innovations with the more radical innovations that carry higher commercial potential being patented and yet, struggle to gain economic benefit from the commercialisation of these patents (Latif et al., 2016). Sri Lanka is no exception. The reason for non-achievement has been tagged to the uncertainties surrounding new technology and markets (Mohr & Sengupta, 2013; Slater 2005). These uncertainties could be in terms of market acceptance, technology performance, cost of development and production time, cost of production and how rapidly the cost of production could decline due to economies of scale. The rate of application and adaption of the new technology in different industries also influences the success of an innovation. Thus, in the heart of innovation, there is uncertainty. The success of invention also lies with the users and how users view and apply the innovation (Mowrey & Rosenberg, 1999). Therefore, it is essential to note that not all inventions will become commercially successful, as a deep understanding is required of the commercial process of innovation (Jones & Stevens, 1999; Chiaroni et al., 2010). Thus it is said that commercialisation is the 'heartbeat' of innovation. Given the significance of commercialisation, it is crucial to understand what factors determine an invention's commercial success

The outcome of commercial success is influenced by key factors and decisions taken in the earlier stages of idea generation, conceptualisation and prototyping.

Market orientation (MO) is a critical factor determining the ability to understand customer needs and maintain that understanding throughout the innovation process from the outset of technology development. This understanding is through in-depth knowledge of expressed and latent customer needs that need to be addressed (Slater & Narver, 1995).

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Therefore, proactive market orientation is strongly associated with innovation and new product success (Narver, Slater & MacLachlan, 2004; Jiménez-Jiménez et al., 2008). MO has been defined as a firm's organised market intelligence gathering of current and future customer needs, disseminating this market intelligence across all departments and the organisation's responsiveness to it (Kohli & Jaworski, 1990). Narver and Slater (1990) defined MO through three behavioural components: customer orientation, competitor orientation and inter-functional coordination. Both definitions point to a proactive, continuous process that involves anticipating and meeting customer needs whilst scanning the existing options (competitor scanning) available that satisfies customer needs. The two definitions indicate the importance of new products, new and novel technology that may be patented to effectively utilise the customer and competitor knowledge gathered to target potential customers unfulfilled or latent needs. Prior studies supported this premise, identifying the importance of uncovering latent customer needs, involving customers throughout the development for constant feedback and refining the technology, thereby increasing the invention's commercial potential.

The patented innovation also needs to get diffused amongst industry for commercial development and society for commercialisation (Rogers, 1995). The patented invention needs to gain acceptance by those who require it and those who benefit from it. The attributes and the benefits of the innovation need to be communicated and demonstrated. This process takes time and depends on the communication channel, the social system, and the invention's attributes (Rogers, 1995). Therefore, market orientation (MO) and the diffusion (DF) of patented innovation are likened to a coin's two faces. Each important and contributing to the commercial potential, each reflective of the other for its purpose fulfilment. Successful application of market orientation and the inventions diffusion characteristics are essential in the Sri Lankan context to link Industry with Research and Development and patented inventions.

Amongst the body of innovation literature, an emerging topic is the commercialising of innovation and patented innovation. Patents are essential as they represent radical and higher value technology and rate a country's innovativeness. Patents represent substantially new ideas and concepts and are the best definition for radical innovation (Stevens, Greg, Burley & James, 1997). Applying for a patent status for an invention subject the invention to outside expert scrutiny calling for time, effort and substantial financial commitment by the inventor. Therefore, patents represent the innovations with higher potential to commercialise as obtaining patent status for an invention requires time, effort and substantial cost. It also signals to external parties that the inventions have moved from the initial stage of development with a latent and future commercial potential (De Nicola et al., 2018). Hence patents have moved from solely a legal protection instrument to a strategic currency that an inventor can trade between organisations and countries (Chesbrough, 2003; Ruther, 2012). Individual independent inventors and organisations can register patents provided the invention meets the criteria as a substantially new invention that has not been known before the existence of the patent (Walker, 1995) and verified by independent experts in the field through rigorous scrutiny. A unique feature in the National Intellectual Property Office of Sri Lanka database is that independent individuals have registered a significant percentage of Sri Lankan patents.

Sri Lanka is determined to accelerate the country's growth and recognises the importance of innovation and the contribution science and technology can make to achieve this. This contribution would increase the country's per capita gross domestic product, increase exports through value-added exports, and high technology and import substitution. With this objective in mind, the government of Sri Lanka set in place its national policy on Science, Technology and Innovation in 2009. This policy set a clear direction to achieve economic prosperity within five years. However, the achievement of the set objectives fell short. The expected innovation that would stimulate economic development and increase economic prosperity did not take place as expected. The inventions developed by the scientific community failed to impact commercial products by lack of technology transfers to commercial enterprise. Therefore, the non-achievement of commercialisation of most patented innovations is a pressing problem for the country (Wickramasinghe & Ahmad, 2012). The non-achievement of commercialisation attributes to R&D undertaken by academia misaligned with industry needs in terms of identifying market requirements and a lack of understanding between the scientific community and the business community (Innovation and Entrepreneurship Strategy for Sri Lanka 2018 – 2022). In addition, scientific inventions and patents need to be known or diffused amongst industry for commercial development and society for commercialisation (Rogers, 1995). Therefore, the diffusion of patented innovation is vital in the Sri Lankan context to link Industry with Research and Development and patented inventions to identify and cater to trending market needs. Against this background, the study sets out to determine how market-oriented and poised Sri Lankan patented inventions are to gain commercial success and the impact of patent ownership on the two predictors and commercial success of patents. Therefore, the objectives of this study are to determine the effect of market orientation and diffusion on the commercial

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success of Sri Lankan patents and investigate the moderating effect of patent ownership on the two predictors' MO & DF. The study would also explore the use of market orientation and diffusion amongst the two patent ownership groups.

This study comprises four parts. The first part reviews the literature relevant to commercialising innovation, innovation's market orientation, and the diffusion of inventions. Next, the research methodology with data analysis techniques is described, followed by a discussion on study findings. Finally, the study concludes with theoretical and practical implications and directions for future research.

II. Literature Review

Amongst the body of literature on innovation, an emerging and increasingly important topic is the commercialisation of innovation (Schilling, 2005). The commercialisation of innovation takes place in many forms. It could be through transfers, licensing, startups, spin-offs or joint ventures. Within the plethora of innovation literature, the study project commonly known as SAPPHO (Scientific Action Predictive Patterns with Heurnst Origin – Freeman 1967) validated the need to couple new technology with market needs to gain success. The SAPPHO study is a landmark study that added significantly to the knowledge stock on innovation. Forty years thereon, Radosevic and Yoruk (2012) used the same set of success factors to test them out in a knowledge-intensive enterprise industry in Central and Eastern Europe. The results confirmed the continuing relevance of the SAPPHO study. Radosevic and Yoruk study focused on the innovation success factors at the organisation level. The SAPPHO study identified five areas of success. These factors were – better understanding consumer needs, paying more attention to marketing, effective use of outside technology and scientific knowledge, better efficiencies in development and more senior and experienced responsible personnel. Critically analysing these, the attributes of understanding consumer needs and paying attention to marketing could be categorised under a banner of market orientation defined by Kohli and Jaworski (1990) as a set of behaviours and activities that are present in an organisation that is related to generating market intelligence and disseminating the information across the organisation and acting upon the information to cater superior customer value. Nerver and Slater (1995) confirmed Kohli and Jaworski (1990) definition and findings and identified three behavioural characteristics: customer-oriented, competitor-oriented, and inter-functional-oriented. Studies focusing on high technology and radical innovation suggest that market orientation positively impacts such firm performance as it benefits from prior knowledge of solving customer problems and prior knowledge in serving markets. This understanding complements the new technology development creating better acceptance (Schweitzer et al., 2016). A majority of empirical studies carried out show a positive relationship between market orientation and organisational performance (Atuahene – Gima, 1996, 2001, 2005; Tsai et al., 2008; Lukas & Ferrel, 2000; Deshpande et al., 1993, 2004; Vega-Vazquez et al., 2012; Oswald & Brittel, 2017). In their study, Slater and Narver (1994) stated that the likelihood of market-oriented organisations innovating and bringing out new products was greater. Certain studies have empirically tested MO for its moderating influence (Migliori et al., 2018). The empirical research carried out by Vega-Va'zquez et al. (2012), while indicating the positive impact of market orientation on new product development and innovation, stated MO had less impact on radical innovation as customers could not articulate their future needs based on their current experiences. Christensen (1997) study supports this view by demonstrating organisations limitations by addressing only expressed customer needs through incremental innovation and not radical innovation that caters to latent customer needs. However, Slater and Narver's (1998) study contradicts this finding stating market orientation enables the understanding of expressed and latent customer needs. Oswald and Brittel (2017) study support the premise of a significant relationship between market orientation and innovation for both incremental and radical innovation. The salient point of difference in the two schools of thought is that the level of market orientation required for radical innovation success is a deeper and wider understanding of emerging customer requirements (Slater & Mohr 2006; Henderson, 2006). Market orientation may also slow down a firm's response time in instances that demand fast responses to environmental stimuli (Abbate & Cesaroni, 2014). From past studies, it is clear that the degree of market orientation may vary in impact on firm performance, technology transferability, or commercial potential, but it is undisputed that MO positively impacts the commercial success of innovation. Therefore, the study puts forward the hypothesis:

Hypothesis 1: There is a positive relationship between Market Orientation and successful patent commercialisation.

Diffusion in innovation literature has taken different perspectives, with various study models focusing on the multiple aspects of the diffusion process. These diffusion models classify under attributes of technology, communication of technology functionality and alignment with user needs. Rogers, 1995 define diffusion as a process that spreads innovation amongst potential adopters over a while. In theory, put forward by Rogers, he outlines four components or elements that affect the diffusion process: the invention itself, the communication

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channels, the social system, and time. Roger's diffusion model addresses the collective adaptation of an innovation over time. Roger's diffusion models basic premise is that there are different types of adopters whose purchase needs and characteristics differ and could be classified by their traits. Depending on the inventions adaptation swiftness, users can be classified as innovators, early adopters, early majority and laggards. The smooth transition from one segment to another segment of users is termed successful diffusion. An innovation gets diffused owing to the collective adoption of innovation by individuals. The decision to adopt and the time frame to do so vary between persons. In Moor's (1991) study titled 'Crossing the chasm', he identified a gap or a sales slump between the initial innovators and early adopters and the early majority who are the mainstream buyers. Moor argues that this slump is due to the personal characteristic difference between the two categories. People categorised as innovators, and early adopters are generally known to be technology enthusiasts, while the early majority are mainstream buyers who are risk-averse and require proven application. The speed of diffusion would depend on the innovations relative advantage. Increased efficiencies in use and cost will bring about the innovations' comparative advantage. If users do not see a relative advantage, they would not consider using the invention (Rogers 1995). The same sentiment reflects in the Adoption Theory, which addresses the adoption process on an individual basis. All theories on technology adoption and diffusion indicate that it is a complex social development process that needs to address the cognitive, emotional and contextual concerns of individuals (Straub, 2009). Past research clearly shows the adoption of innovation will occur depending on the characteristic of the invention itself, which stems from the ease of use and the compatibility with existing technology. However, the relative advantage alone does not guarantee the adoption or the diffusion of innovation as technological innovations generally undergo lengthy negotiation periods and more disclosure with would-be adopters, which may increase or decrease the relative advantage of the invention (Denis et al., 2002; Fitzgerald et al., 2002).

The diffusion would also be depended on the compatibility with the adopter value norms and perceived needs and existing technology (Denis et al., 2002; Rogers, 1995). The complexity of the innovation, the trialability, (Roger 1995; Plsek, 2003), which in practice refers to the new technology's range of application in an industry or across many sectors (Chunbo, 2018), is yet another critical factor that has an impact on the innovated technology increasing its commercial potential (Slater & Mohr, 2006; Arvantis et al., 2008). This aspect of the characteristic of the new technology and its impact on the commercial potential is relatively under-researched and has not been addressed adequately in research studies (Tornarky & Klein, 1982). Therefore, the focus in this study for the diffusion construct will concentrate on the patent attributes and its impact on commercial success using a reliable scale to measure (Moore & Benbasat, 1991) while predicting the outcome of diffusion based on the success of commercialising the patented invention. Thus, it is reasonable to propose the following hypothesis:

H2: The level of product diffusion has a positive relationship with the level of commercial success of the patent

Patents are the closest to represent radical innovation. Being radical innovation theoretically, they should yield high economic value. However, a majority of patents do not get commercialised and do not contribute to the economy. The economic contribution would depend on the motive for patenting and depend on who owns the patent. Depending on who owns the patent would influence the probability of commercialising (Hellman, 2005; Agion & Tirole, 1994). Patents registered by academia such as IHL's and GRI and individuals would need to attract commercial entities with manufacturing and financial capabilities to further the patents commercial potential. This transfer of technological knowledge could take the form of licensing, spin-offs, startups or contracted research (Mazzoleni, 2005). The ability or inability to attract commercial enterprise would either mean commercial success or failure. Therefore, ownership plays a significant role in commercialising.

Based on past theoretical & empirical studies, this study draws a theoretical framework, depicted in figure 1, to test how the two independent variables of Market Orientation (MO) and Diffusion (DF) contribute to the commercialisation of patents. The model also tests the moderation of patent ownership on the commercial success of patents.

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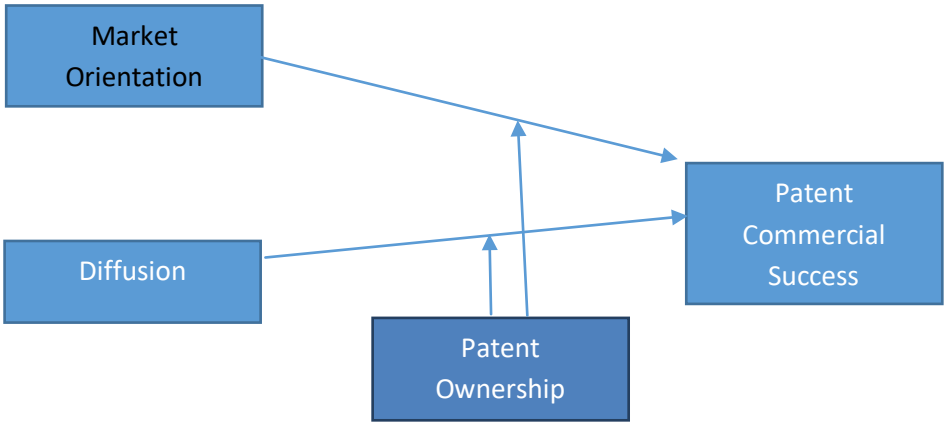

Figure 1: Conceptual Framework of Study

III. Research Methodology

The study objective was to empirically validate the research hypothesis to ascertain if there was a relationship between market orientation and commercial success of the patented invention and if patent ownership moderated this relationship. Likewise, the following hypothesis explored a relationship between diffusion of the patented innovation and the commercial success and if patent ownership moderated this relationship. The study objectives and hypothesis is addressed through a quantitative cross-sectional study based on a national framework of patents held by Sri Lankan nationals registered through the National Intellectual property Office of Sri Lanka or registered through the Patent Cooperative Treaty (PCT). The framework limited the registration of the patent to five years from 2010 – 2014. The total number of registered patents during this period with both databases were 435. Based on the t-table developed by Krejcie and Morgan (1970), the sample size was determined as 205. The sampling process made allowance for non-response, and the number of respondents selected increased to 330 respondents. A response rate of 66% was achieved, which resulted in obtaining a sample of 220. Since the databases of NIPO registers 70% independent individuals, it was necessary to collect sufficient numbers from the organisation group. Therefore, the study used a random disproportionate stratified sampling method to obtain adequate representation for analysis purposes from the two patent ownership categories: Independent Individual patent holders as one category and the other as Patents owned by Organisations, including IHL's GRI's and commercial organisations. The sample was equally distributed among the two ownership categories so that adequate representation for each ownership category was in place for concluding the study. (Refer Table 1). The unit of analysis was the patent holder. The identity of individual patent holders is straightforward. However, in organisational patent ownership, identifying the respondent or the unit of analysis gets complicated as the patent outcome could result from several people. In such instances, the respondent selected was either the lead researcher or named patent researcher or the research director or a key senior executive involved with the patent idea, prototyping and commercialising it.

Table 1: Distribution of Sample

Ownership Category	N	%
Organisation	114	51.8
Individual	106	48.2

The questionnaire was developed by adapting both MKTOR and MARKOR scales (Narver & Slater, 1990; Kohil, Jaworski & Kumar, 1993) and scales used by Rodoservic and Yoruk 2012 in the SAPPHO study to test the Market Orientation dimension. The measurement carried 8 item scales. The diffusion dimension was tested by adapting the scales developed by Moore and Benbasat (1991). The 12 measurement scales assessed the likelihood of the inventions diffusion was based on the characteristics of the invention identified by Rogers (1995).

The questionnaire rated the response on a 5 point Likert scale from strongly disagree (scale of 1) and strongly agree (scale of 5) for both the Market Oriented and Diffusion constructs. The dependent variable questions were based on the Pat Val study (2005). It comprises four objective dichotomous questions with yes and no responses. In addition, the questionnaire

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extracted information on commercial success, citation, patenting outside the country (Family size), which would also indicate the patent strength. The questionnaire also carried questions relating to the demography of the patent holder in terms of gender, age, experience, qualification and number of patents owned. The questionnaire was mailed or emailed to respondents, but due to poor initial response, rigorous follow-up through email correspondence, telephone and personal contact through visits were made. Data collection took five months.

The questionnaire was first pre-tested among 32 respondents with a mixed representation of inventors from IHL's, GRI's Corporates, and Individual patent holders to ensure the questions' content, clarity, and validity. Based on the feedback of the pilot study, 1 item scale was dropped from the MO dimension, and two-item scales were dropped from the Diffusion dimension. The questionnaire was also refined by making minor changes to terminology to suit the scientific community of patent holders. The questionnaire was developed in both English and Sinhala.

The findings of this study were tabulated using descriptive statistics on demography and patent details, frequency, reliability testing to ascertain the consistency and reliability of the variables, Pearson's correlation analysis to measure the multi-collinearity and Multiple regression analysis to test the hypothesis and identify the most influencing variable contributing to the commercial success of patents. Multiple Regression was used contrary to the common belief that Logistic Regression is more appropriate than linear regression for analysis with a dichotomous dependent variable. Past comparison studies between the linear and logistic regression have shown near-identical outcomes (Hellevik, 2007). Furthermore, ANOVA has been proved to be robust to show relevant results if the data in the two samples cell proportions are equal or are between .25 and .75 and there are at least 40 degrees of freedom (Lunney 1970; D'Agostino, 1971). This study's sample data meets the condition specified by Lunny (1970) and D' Agostino (1971) with cell proportion .37 and .63 ANOVA was run after transforming the data values.

IV. Results

The Socio –Demography profile of the respondents who participated in the research is given in Table 2. The majority of respondents were males (86%), while the majority fell into the age groups between 35 – 55+, indicating a mature profile of inventors and researchers. Furthermore, most surveyed respondents were tertiary qualified (78%) and well experienced, with most respondents (70%) having over ten years of experience as inventors. In addition, 58% of respondents held more than one patent, and amongst them, 10% owned more than five patents. These statistics indicate a well experienced, knowledgeable and active profile of Sri Lankan patent owners.

Table 2: Socio- Demography Profile of Respondents

	n	%
Gender		
Male	189	86
Female	31	14
Age		
14 - 20	3	1
21 - 34	39	18
35 - 44	55	25
45 - 54	60	27
55+	63	29
Education		
O/L	8	4
A/L	39	18
Graduate	56	32
Masters	46	20
PhD	71	26
Experience		
less than 5 years	15	7
5 - 10 years	52	24
More than 10 years	153	69

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Patents Owned		
Single patent	91	41
less than 5 patents	105	48
More than 5 patents	24	11

In terms of the patents, the number of patents commercialised was 81 or 37%, of which 60 were owned by organisations and individuals owned only 21. Very few patents were registered outside the country (11%), of which organisations owned 21. 16% or 36 patents were stated as cited, of which organisations owned 32. This indicates an overall portfolio of weak patents, with stronger ones owned by organisations (Refer Table 3).

Table 3: Patent Value

Value Dimension	Organisation		Individual	
	n	%	n	%
Commercialised	60	27	21	10
family size	21	10	3	1
cited	32	14	4	2

Based on the respondent and patent profile, it is apparent that whilst the inventors are well experienced and knowledgeable, the overall patent value is weak based on the criteria for valuing patent worth: citation, family size, and renewals (Maurseth, 2005; Svenssen, 2010).

The analysis of the study commenced with the constructs of the questionnaire being first checked for internal consistency to ascertain how closely they represented the single latent variable. This was verified through the Cronbach Alpha test, which was > .7 for the MO and DF constructs (Refer Table 4). A Cronbach Alpha score of .9 is considered excellent reliability, while a score between .8 and .9 is deemed to be good and a score between .8 and .7 is considered acceptable (Nunnally)

Table 4: Test for Reliability

	Pilot Study		Final Study	
Variable	No. of Items	Cronbach Alpha	No of Items	Cronbach Alpha
Market Orientation (MO)	8	0.779	7	0.912
Diffusion (DF)	12	0.879	10	0.885

Though the pilot test Cronbach Alpha scores for both dimensions were acceptable, one item scale was dropped from the MO dimension, and two-item scales were dropped from the Diffusion dimension as most respondents felt the scales were either confusing or not relevant which improved the CA rating for both dimensions in the final study.

The construct validity was also tested to assess how well the results of the data gathered from the scales used to measure the constructs fit the theory around which the research is designed. This was done using correlation analysis and factor analysis. The KMO test was also run to ascertain sampling adequacy. The KMO measures the proportion of variance in the scales that may result from an underlining factor. KMO measures vary between 0 -1, with a value closer to 1 being considered excellent with a value of.6 is the minimum acceptance value. The results from these tests are given in Table 5.

Table 5: Factor Analysis

Variable	KMO	Bartlett's Test	Factors	Variance	Items
Market Orientation (MO)	0.899	0.000	Single	0.72	7
Diffusion (DF)	0.818	0.000	Single	0.72	10

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The internal consistency was also examined by calculating the Composite Reliability (CR) and the Average Variance Extracted (AVE). The construct values for the AVE are>. 5, and CR is >.7 (Hair et al., 1998; Fornell & Larcker, 1981). The values for both the constructs are above the cut off values which confirms the validity of both the construct and the individual items are high and meet the measurement requirements for further analysis (Refer to Table 6)

Table 6: Reliability of Item Construct

Construct	No. of Items	AVE	Composite Reliability
Market Orientation (MO)	7	0.71	0.94
Diffusion (DF)	10	0.63	0.93

To measure the operationalised accuracy of the construct, the construct validity was checked using both convergent validity and discriminant validity. The discriminant validity is measured by squaring the correlation and then the squared correlation is compared with the AVE, which should be greater (Fornell & Larcker, 1981). The results meet the requirement establishing the discriminant validity of the two constructs (Refer Table 7).

Table 7: Discriminant Validity

Variable	Mean	St. Deviation	Variables	
			MO	DF
MO	3.22	1.06	**0.71**	0.68
DF	3.49	0.76		**0.60**

In the factor analysis, all correlation coefficients of inter construct were within the range of .3 - .9, indicating the absence of multi-collinearity and all factor loadings were above .7. Thus, the value of the construct was established.

A comparison of means was run by carrying out an independent t-test by ownership as the study was conducted in a national framework that included two distinct patent ownership groups. The independent t-test was selected as it compares the means between two unrelated groups on the same continuous dependent variable. The variance in the Standard Deviation shows a difference in the mean scores of the two constructs for the two ownership groups, as reported in Table 8.

Table 8: Result from the Independent t-test for ownership

Variable	Ownership	Mean	SD	Levene's Test		t	df	Sig(2 tailed)
				F	Sig			
MKT Orientation (MO)	Individual	2.86	1.024	0.003	0.957	5.005	218	0.000
	Organisation	3.55	0.996					
Diffusion (DF)	Individual	3.31	0.689	9.565	0.002	-348	216	0.000
	Organisation	3.66	0.799					

N Organizations 114, Individuals 106

The result of the t-test indicates a difference between the mean scores of the two ownership groups. The t-test result of the independent variable MO shows a significant difference between the mean score of MO for Organisations (M=3.55, SD=.99) and Individuals (M=2.86, SD=1.02), conditions; t (218) =-5.00, p=0.001 indicating organisations are significantly more market Oriented throughout the innovation process.

The result of the t-test for the independent variable Diffusion (DF) shows a difference between the mean score of DF for Organisations (M=3.66, SD=.798) and Individuals (M=3.31, SD=.689), conditions; t (218) =-3.4, p=0.001. This indicates organizations innovations comply more with the diffusion product characteristics than those patents owned by Individuals. The regression analysis was used to test the hypothesis relationships of the study with the sample population. The analysis indicates a positive relationship between each independent variable: Market Orientation and Diffusion with the dependent variable commercialisation. In addition, ownership as a variable showed a positive relationship with the dependent variable as well (Refer Table 9).

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Table 9: Regression Coefficients of Independent variable on Dependent Variable

Variable	Standardised Coefficient		t	p	Collinearity Statistics	
	St. Error	Beta			Tolerance	VIF
(Constant)	0.022		0.000	1.000		
MO	0.046	0.106	2.300	0.022	0.238	4.206
DF	0.045	0.292	6.443	0.000	0.244	4.096
Ownership	0.032	0.103	3.248	0.001	0.496	2.017

In the regression analysis, Market Orientation is found to be positively associated with patent commercial success (β= .106, p< .05), supporting H1. Diffusion was also positively associated with patent commercial success (β= .292, p< .05) supporting H2. Ownership is also significant (β=.103, p<.05), indicating that ownership impacts patent commercial success.

The overall model fit was also checked, which resulted in the linear regression model being statistically significant. The model explained 79% (R2) of the variance in commercialising with a p=.001.

To test hypothesis H3 of patent ownership moderating the relationship between market orientation and patent commercial success, the independent variable with the standardised moderating variables were included in the regression analysis. The ANOVA indicated model 1 without the interaction term significant at F (2,217) = 269.60, p<.001 while model 2 with the interaction term was also significant at F(3,216) = 220.54, p=.001 indicating the interaction between patent ownership and MO account for significantly more variance than just MO and just patent ownership singularly as the model R2 change .o41 p=.001 or a 4.1% increase in variance explained by the interaction term thus confirming H3 hypothesis: Patent ownership moderates the relationship of market Orientation on commercial success.

Table 10: Ownership Moderation on Market Orientation Model Summary

Model	R	R2	Adjusted R2	Std. Error of the Estimate	Change Statistics					Durbin Watson
					R2 Change	F change	df1	df2	p	
1	.844	.713	.710	.53814566	.713	269.607	2	217	.000	
2	.868	.754	.750	.49953524	.041	35.841	1	216	.000	1.445

To test the hypothesis H4 of patent ownership moderating the relationship between diffusion and patent commercial success, the independent variable with the standardised moderating variable was included in the hierarchical regression analysis. The analysis is given in Table 11.

Table 11: Ownership Moderation on Diffusion Model Summary

Model	R	R2	Adjusted R2	Std. Error of the Estimate	Change Statistics					Durbin Watson
					R2 Change	F change	df1	df2	p	
1	.878	.771	.769	.48056592	.771	365.642	2	217	.000	
2	.882	.778	.775	.47473426	.007	6.364	1	216	.012	1.646

The analysis accounted for more variance than just the independent variable diffusion and patent ownership. Model 1 without the interactive term is significant at F (2,217) =365.64, p<.001. The R2 change .007 p=.012 confirming patent ownership moderates' diffusion to patent commercial success. Hence hypothesis 4 is confirmed.

V. Discussion

The study reveals that both market orientation and diffusion have a significant positive impact on the success of patent commercialisation. Therefore, to improve the commercial success rate of patents, the inventors who are patent holders need to develop their new technology incorporating the aspects identified through MO, which will reflect in DF if implemented. It is paramount that the patent owners understand the success of patents depend on the technical quality, the market opportunity and the technological obstacles (Chunbo 2017). Constant scanning of market shifts in terms of consumer requirements and competitor activity is required throughout the innovation process. The market scanning requires a high level of interaction between the potential user groups and constantly

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receiving feedback on the attributes of the developing new technology and adapting them to transform the technology to create a superior product with demand. It is then that the potential of commercial success could increase.

The study findings for the predictor variable market orientation supports the findings of past studies. The results support the empirical findings of Radosevic and Yoruk, (2012) and again validated with more recent studies by Wang, Zhao and Voss, 2016; Chunbo, 2017; Kadir and Shamsudin 2019. These studies have been carried out in different countries, strengthening the empirical findings further in this area.

While the study highlights the importance of MO in the commercial success of the patent it also highlights the difference of MO based on patent ownership tested through a t-test where the patents owned by individuals indicated lower mean value (2.86) compared to patents owned by organisations (mean value of 3.55). The study data reveals that organisation-owned patents were stronger patents as they were subject to market scrutiny and evaluation and reflected it in the technologies characteristics or features that were trialled with potential users, thus enabling the patents to have higher commercial success. The difference between the two groups was mainly due to the individual inventors lacking funds to continue with prototypes and testing them with potential consumers.

This finding has significant implications for the individual patent holder and innovation policymakers who need to assist them in accessing funds to build prototypes and test them with potential users. Individual patent holders must have access to venture capital and other external financing avenues that will facilitate and assist in reaping economic value from patented inventions as they dominate the country's innovation landscape. This could be in the form of grants or loans underwritten by the government and linked to favourable payment plans based on revenue generation from the successful commercialisation of the patent. This would enable individual patent holders who commercialise their patented technology by startups or existing SMEs to increase the economic value generation through upscaling. Multi-disciplinary services and skills are also required during the commercialising stage, which the individual patent holder may not possess but would need to acquire for commercial success. Inventors possessing services such as marketing, management, manufacturing in-house stands to increase the probability of commercialising. Therefore, access to such disciplines is also essential to both groups.

The study findings for the predictor variable diffusion helps to predict the success of commercialisation based on the new technology adoption characteristics. The findings help evaluate and understand the current level of innovation characteristics that would enable the diffusion of patented innovation in Sri Lanka. The study results support the findings of past studies carried out by Chunbo 2018; Ostlund 1974; Lo, Wang, Chien and Hung 2012. It indicates the importance of developing technology characteristics that are in line with market demand, leading to a higher potential of commercial success.

Innovations meeting the market orientation and diffusion criteria would also lead to higher valued patents that could then be supported and backed by the state to further the commercial potential through patent registration in other countries and negotiating with overseas patent buyers and local manufacturers for profitable licensing and other contracting.

VI. Conclusion and Managerial Contribution

This study contributes to the body of knowledge in various ways. Firstly, the study model is tested in a national setting combining different patent ownership categories, which are scarce, especially in the context of developing counties. Most innovation studies carried out concentrate on a single ownership category, most often based on organisations such as technology transfers or commercialising of IHL innovations or technology transfers or commercialising of GRI innovations or limited to technology spin-off or startup organisations commercial performance. Studies that combine ownership groups in a wide range of industries, as in this study, is rare.

The study also contributes to an area of limited literature by studying innovation diffusion based on the characteristics of the innovation. It examines 5 innovation characteristics in a national setting across several innovations. Studies that exist either use one or two characteristics or limit the research to a specific innovation. As a result of these two limitations, the reliability and replicability are low (Tornatzky and Klein, 1982). This study uses the characteristic of innovation for diffusion in a replicable model, using tested and reliable measures with statistical power to predict the outcome, contributing to this knowledge gap.

As a result, the study gives deep insight into the use and practice of two critical variables identified as necessary for the commercial success of new technology by empirically validating the use of the Market Orientation variable and the Diffusion variable along with its use by innovation ownership in the commercialising process which is represented in this study by patents.

Every research study has its limitations that arise from the methodology, research context, or biases from survey respondents. The sampling process in this study combines three ownership segments: IHL's, GRI's, and Commercial organisations under one ownership category of Organisations. These three segments would most likely vary in their research needs, research

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motives, availability of resources and expertise, which would influence the commercial outcome of the patented research. The combined ownership is a limiting factor as the diversity and approach to commercialisation would differ within each segment. Future research should investigate the segments separately and compare them for deeper understanding. The study also limits its framework to a five-year window, which could be extended to include the more recent patents that have emerged within the countrys' more recent National Innovation System. Incorporating the newly established intermediaries and enacted new policies to increase the country's innovation capacity may improve and expand future study findings. It will also contribute to furthering knowledge in an ever-important area of organisational and national importance.

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