

Intellectual Property Rights as a Catalyst for Innovation and Competitive Advantage in the Digital Economy: A Quantitative Analysis

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Abstract: This study investigates the role of intellectual property rights (IPR) management as a catalyst for innovation and competitive advantage within the digital economy. We employed a quantitative cross-sectional design across 180 organizations, collecting data from 981 valid respondents through structured questionnaires and secondary sources. The analysis utilized multiple linear regression, structural equation modeling, and confirmatory factor analysis to examine relationships among IPR management, R&D investment, digital innovation adoption, knowledge management, and organizational performance. Our results indicate that comprehensive IPR management significantly predicts innovation performance ($\beta = 0.46, p < 0.001$), with the overall model explaining 75.8% of the variance. A strong positive correlation emerged between IPR management and innovation performance ($r = 0.83, p < 0.001$). Furthermore, organizations with robust IPR strategies demonstrated 29.3% higher innovation performance, 25.7% greater technology commercialization, and 24.6% stronger competitive advantage compared to those with limited practices. The structural equation model exhibited excellent fit indices (CFI = 0.98, RMSEA = 0.043). The novelty of this research lies in its integrated framework that quantifies the synergistic effects of patent protection, copyright management, trademarks, and digital strategies on organizational outcomes. We conclude that effective IPR management serves as a fundamental driver of sustainable competitive advantage in digitalized markets. These findings provide actionable insights for policymakers and organizational leaders seeking to optimize intellectual property governance, thereby fostering innovation-led growth in the digital economy. The study contributes to the literature by empirically validating the mediating role of knowledge management and technology commercialization in the IPR–innovation nexus.

Keywords: Intellectual Property Rights, Innovation, Competitive Advantage, Digital Economy, Quantitative Analysis

Introduction

This means the digital economy has turned the way businesses are organized, production processes are conducted and the regions' developed around upside down (Malecki & Moriset, 2007). It includes digital platform ecosystems in which start-ups, technology firms, manufacturers and research institutions are now more and more interconnected, in a variety of ways and through value chains that typically cross their organizational boundaries. In this ecosystem, intellectual property rights (IPR) have emerged as significant assets to help innovators' ensure more competitive innovation and innovation performance (Davis, 2004). The dynamism of the digital world poses new difficulties and tensions for traditional IPR systems, however, due to how fast it fast-track processes. As the world keeps moving, there are equally issues and challenges with the traditional IPR systems – but fast! Practitioners and policymakers are now eager to know how to properly manage an organisation's intellectual property to support innovation and expansion in commerce.

There has been a large amount of previous literature on the effects of IP protections on firm performance, and several studies found that IP protection can create an apparatus to incentivize innovations (Genevieve Yuan & Min Li, 2025). Research shows that, for example, protecting IP has a positive effect on the development of the digital economy and regional entrepreneurial activity of small and medium enterprises (SMEs) (Chen, 2022). Similarly, research carried out on services provider has revealed that IPRs have an effect on the service providers, and the direct connection between IPRs and the service providers is mediated via process innovation and organizational innovation as intermediate variables (Pak et al., 2025). The literature, however, is only static on the matter of IPR management; it's only in legal terms; it doesn't define IPR as a strategic management competence and instead of becoming a component of the digital innovation strategy, knowledge management system, and technology business process, the literature sees it as a legal tool. For instance the difference between products, services and platforms is increasingly melting away in the digital economy, creating an especially apparent impenetrable border in this instance.

This study, for the first time, proposes to examine the interaction between the five dimensions of the digital innovation policy continuum (patent protection, copyright management, trademarks, digital innovation strategies and R&D investment) and their consequences at the organizational level on innovation, competitiveness and business growth and empirically tests the suggested consequences. From the above we hypothesize that integration of comprehensive IPR management, digital innovation and knowledge management system can significantly impact on the organizations' performance. The main goal of this research is to measure these factors' synergistic effects with a stringent quantitative model. For this, we opted a cross sectional design incorporating individual structured questionnaires for 180 entities and also a secondary source of 981 valid answers. To test hypothesized relationships, a multiple linear regression, SEM and CFA were used.

There are three major contributions this research that provides. First, we present empirical evidence: Companies with more complete practice performance metrics were 29.3% more likely to have high degrees of innovation than were companies with fewer, and companies with fewer practice performance measures were 25.7% less likely to have high degrees of technology commercialization. Thirdly, we confirm that the links between IPR and organizational outcomes are partially mediated by KM and technology commercialization, thus extending the theory of the relations between the IPR and the organizational outcomes. Third, our findings provide guiding principles for policy makers and organisational leaders that want to make the best use of IP in the context of the swift digital evolution. Section 2 provides a review of the literature related to digital economy ecosystems and strategies for

IPR management. The methodology is described in Section 3 which includes the research design, the sampling process and the analytical technique. The empirical results are given in section 4. These findings are discussed in regard to their implications in section 5. The paper concludes in Section 6, providing suggestions for further research and practice.

Literature Review

The digital economy has both revolutionized the production, protection and commercialization of intellectual assets and significantly changed the way that organizations now engage in these activities. The digital economy has had a dramatic impact on the way we can create, safeguard and monetize IP assets and in doing so, the rules of IP should be rethought. Empirical research has revealed that intellectual property rights (IPRs) is an important instrument that is employed in securing returns from the investment in innovation, particularly in the knowledge-driven industries (Davis, 2004). However, due to the nature of digital goods and their features – for example, the fact that digital goods can be reproduced with low marginal costs and easily distributed globally – traditional approaches to IPR enforcement in practice are difficult to attain. (Celestin, 2024) Therefore, scholars have proposed that IPR management in a digital environment does not have to become only a legal issue, but rather must be a part of the Strategy of Digital Innovation and become a system of Knowledge Management (Teece, 2017).

A thorough effort has been made to understand the direct relationship between IPR protection and the outcomes of innovation for the company. However, research has demonstrated that IPRs create value for service firms in the form of process and/or organizational innovations, indicating the importance of the value of the IP beyond legal monopoly rights (Pak et al., 2025). Similarly, some studies indicated positive impacts on small and medium entrepreneur business (SME) activity when the effect of IP mentioned on the development of Digital Economy (Chen, 2022). These findings are in line with other frameworks that view IP regimes as a collection of institutions that affect the incentives for innovation and limits on the spread of technology (Yuan and Li 2025). But the bulk of such work takes an exogenous perspective on IPR protection, as something that organisations must simply accommodate, rather than seek to manage and optimise.

Later on, researchers began to concentrate on the strategic factor related to the IPR management and the importance granted to businesses with its management to achieve competitive advantages. In the digital domain, “profiting from innovation” emphasizes the fact that a group of complementary assets (such as manufacturing assets, distribution channels, brand reputation, etc.) is required for the profits of IPR ownership (Teece, 2017). From this perspective, IPR management does not fit into the scope of wider business model innovativeness but rather has to engage several transactions with/proximity to platform users in value creation and capture (Acs et al., 2021). Furthermore, the IP rights' contribution to research on economic growth in the digital economy presented several arguments for initiating a policy dialogue and for a balance between protection and access to IP rights, including, on the side of protection, that IP rights regimes that are overly restrictive can hinder the cumulative nature of digital innovation (Ciocoiu, 2011).

The positioning of knowledge management as a mediating factor in relationship between IPR and innovation is gaining more and more interest. Innovation capabilities in the sense of being able to actually create innovation deliverables from IPR will be stronger if the IPR is captured, understood, formalised and shared systemically throughout the organisation (Holgersson, 2012). This is particularly the case in the digital economy, as knowledge is fragmented into organisations and structures, and shared over collaborative platforms, open innovation and data sharing deals. Based on practical

experience, the companies that have developed the integrated knowledge management system will have higher proportion of technology commercialization and will be more competitive with technology positioning and able to implement more effective IPR strategies to keep up with the advantage of the market opportunities (Mansy, 2022). Knowledge management (KM) interactions as they relate to the IPR governance framework in which they occur to inform innovation performance is, however, poorly understood quantitatively from a specific mechanism perspective.

Regardless of these developments there are still a number of gaps in the literature. Over the first point, most of the literature on IPR protection and innovation performance focussed on a single IPR instrument, such as a patent, as opposed to the combined effect of several IPRs instruments when they are combined into a strategic package of protection. Second, the mediation mechanism are still under not well quantifiable between the relationship between IPR and innovation through structural equation modeling approach. Third, the need to adopt digital innovations is well understood, but such empirical testing of the moderating and mediating effects of digital strategies between IPR management and organizational outcomes has been almost lacking. In the current study these gaps are explored by building an integrated framework considering various aspects that are related with the performance of the Innovation, Technology Commercialisation and Business Growth aspects, such as Patent Protection, Copyright Management, Trademarks, R&D investments, and the adoption of Digital innovation and Knowledge Management. The methodology employed in this study is strong quantitative, as it provides empirical data about the synergistic impact the IPR management can have in this particular context of the digital economy, by incorporating a wide range of intangible property-related organizations.

Methodology

Research Design and Sampling

The study design was quantitatively been used with the concept of cross section study of Digital economy where theory of intellectual property rights (IPR) management although forwarded was investigated with respect to theory of organizational innovation performance. The design was selected because it offers several measures which could be implemented in a variety of contexts, and covers the potential to identify patterns and associations of measures that could not be obtained through case study and/or qualitative assessment. The study was carried out in 180 different organisations representing a wide spectrum of the digital economy ecosystem, from technology companies, research institutions, startups, manufacturing companies to digital enterprises. The total population included 1000 subjects, who have been selected using Stratified random sampling techniques comprising of Innovation managers, R&D professionals, learners, Legal specialists, Entrepreneurs and Senior executives. To ensure there was equal distribution of number of organizations by type and size, as both these factors have been found to impact IPR management practices and results of innovation in previous studies (Davis, 2004), stratification was conducted.

Data collection instruments and variables

Primary data was collected through questionnaires, which were completed solely by the respondents, and with the help of expert interviews (to validate the questionnaire and logs of qualitative data that could help to analyse the quantitative data). A questionnaire was developed by modifying previous questionnaires from literature (Holgersson, 2012) and then refined with a pilot study of 50 participants to see if the items were clear, reliable and had construct validity. Secondary data was sourced from the patents application, trademark registration and R&D investment rates at the intellectual property offices, company annual reports, Innovation database, and policies document files in the digital economy, which

provided the objective data for patent application, trademark registration, and R&D investment rate. The variables collected were: organisation size; industry sector; innovation investment in research and development; patent applications; trademarks; copyright protection; IP management practices; digital innovation; technology commercialization; knowledge management; capabilities of innovation; competitive advantage; business growth; and organisational performance. The items corresponding to each variable were rated with five-point Likert scales, after a reliability test the composite variables were generated by averaging items.

Data Pre-processing & Data quality Assurance

Data were then systematically pre-processed depending on the aim of analysis to avail the results as legitimate. The responses from 1,000 attempted responses yielded 981 valid responses (98.1% response rate) which were analyzed. Thus the median was calculated to solve problems of missing value imputations for continuous variables, and is appropriate for continuous variables because it did not influence the central location of the distribution even if there is an outlier. To ensure a consistency in the responses, encoding and validation of data were done: categorical variables were numercoded, continuous variables were logically validated across responses. To look for the outliers in the data the Interquartile Range (IQR) method was used, with values outside the range being flagged for further inspection, there were no extreme values to remove. The data from these continuous variables were transformed into their range of 0-1 (Min—Max method) due to their different scales and units. The internal consistency was assessed using Cronbach's Alpha with values $\alpha < 0.80$ considered to be an acceptable level of internal consistency.

Composite Index Construction

A number of composite indices were constructed which encompassed several aspects of the constructs under investigation. The IPMI was created by combining the scores of the four items according to their Principal Component Analysis (PCA) scores on the basis of the "approved importance of each. Similarly, the data for Innovation Performance Index was obtained by nesting together innovation performance data in terms of new product development and process innovation and innovation efficiency. Digital Innovation Adoption Index (AI) highlighted the adoption of digital technologies in the context of innovation process, including AI technologies, cloud computing and data analytics. The Knowledge Management Index showed the degree to which the internal systematics were in place to capture, codify and disseminate the intellectual property of the firm. The Technology Commercialization Score utilized the timing and effectiveness of the performance in converting R&D outputs to commercially viable product/service. Lastly, scale measures of perceived market positioning (Competitive Advantage Index) and revenue growth (Business Growth Index) were measured. These indices were the main indices used to analyse both dependent and independent variables.

Statistical Analysis Framework

There were multiple stages to the analytical strategy. Descriptive statistics had been done in order to obtain the characteristics of the sample and variables. Secondly, the bivariate correlation among the constructs was explored to get the initial sense of associations between the constructs using 2nd Pearson correlation. Thirdly, multiple linear regression was conducted to demonstrate that the regression of which term on the Innovation Performance Index would be significant. A regression model that was formulated was:

IPM (Intellectual Property Management Index), RD (R&D investment), DIA (Digital Innovation Adoption Index) and KM (Knowledge Management Index). Finally, the hypothesized causal relationships between the latent constructs were tested by the application of Structural Equation Modeling (SEM) by using AMOS software; the validity of the model was determined by Chi-square/df, Comparative Fit Index (CFI), Tucker–Lewis Index (TLI) and Root Mean Square Error of Approximation (RMSEA). Then Confirmatory Factor Analysis (CFA) was conducted in the 5th Measurement Model where all variables that were observed were related to the underlying latent variables. The statistical analysis was done with SPSS 29, AMOS, R (Version 4.3) and MS Excel and significance level was finally fixed at .

Results

The results for the statistical analyses are presented in the following subsections: A description of the sample characteristics is presented, after which key findings from the regression, correlation and structural equation models are presented. These analyses together assure regular empirical documentation of the relations between the management of intellectual property rights, digital innovation strategies and the performance outcomes of organizations.

Participant Characteristics

Following the methodology applied in the data cleaning phase and the data pre-processing phase, 981 valid answers were analyzed overall (98.1% of the 1,000 possible answers). To account for this, the participant characteristics were analysed according to organizational type and IP portfolio status. Organizations had a great mix in terms of organizational representation, technology firms being the largest (35.6%) and then manufacturing companies (24.8%), research institutions (18.3%), digital startups (13.5%) and organisations within other sectors (7.8%) as shown in Table 1. The selection of the distribution method was strategic, aiming to target a wide range of digital economy ecosystems, from large industrial companies down to the emerging ones, who are small entrepreneurs.

Table 1. Participant characteristics by organizational type and IP portfolio status

Characteristic	Percentage
Technology firms	35.6%
Manufacturing companies	24.8%
Research institutions	18.3%
Digital startups	13.5%
Other sectors	7.8%
Organizations with active IP portfolios	78.9%

A significant result of the participant characteristics analysis was that 78.9% of organizations in the sample reported having active IP portfolios, meaning that the majority of organisations surveyed reported an IP portfolio. The high rate of active IP holdings is in line with existing literature that has highlighted the IP portfolios as being an integral part of the business strategy in knowledge-intensive industries (Davis 2004). The number of business representatives in the sample, at 32, is comparable compared to the “core business” of patent and trademark, and the cultural diversity of the institutions involved, in the field of arts and culture, in addition to the research and digital start-ups, parallels the growing scope of non-traditional actors in the field of innovation. The remaining 7.8 per cent of

organisations did not fit into any other categories, including service providers, but also consultants and non-profit organisations which further broadened the generalizability found to the studies conducted in a wide range of organisations. The above-mentioned characteristic of the actors provide a solid ground for both analytical and discerning analysis of the relations between IPR management and digital innovation strategies – to organizational performance outcomes to be done in the course of the next phase of analysis.

Study of innovation and IP protection. Research on IP & innovation practices.

The analysis of handling of IPR and use of formal innovation related practices within the surveyed organisations revealed that the innovation related practices and innovation related activities, which are relevant to handling of IPR, are present to a large extent. Most organisations reported structured IP related governance, and there were reports of IP related investments in innovation, as shown in Table 2. Specifically, 81.6% of organisations had an IP management policy; almost all firms knew that “the systematic management of IP policy is important in the context of the digital economy””. The result is consistent with previous studies that focused on the institutional foundations of the returns to innovation investments, formal IP policies (Davis, 2004).

Table 2. Intellectual property and innovation practices across sampled organizations

Practice	Percentage of Organizations
Maintained formal intellectual property management policies	81.6%
Invested regularly in research and development activities	76.8%
Actively filed patent applications	72.9%
Implemented digital innovation strategies	69.7%
Adopted knowledge management systems to support innovation	74.5%

Speaking of investments for innovation, 76.8% of organizations said they do normal investments in research and development (R&D) activities, highlighting the relevance of R&D as an instrument for technological advancement and in the competitive positioning. Furthermore, 72.9% of businesses were filing patents which shows that patent protection remains the preferred choice for IP rights over traditional manufacturing and digital technology based products, among the organisations. Sixty-nine point 7% of organizations had implemented digital innovation strategies, although digital tools and platforms could be more integrated into the innovation process. Further, 74.5% of the organizations has mentioned that they had implemented knowledge management systems to enable innovation, meaning to say that they need to capture and share knowledge as a part of their program and integrated knowledge management has a significant portion in enabling the effectiveness of their IPR management and R&D efforts (Holgersson, 2012).

Generally, the findings show high levels of traditional IPR awareness and use within the organisations sampled along with high levels of innovation (like having a digital strategy or knowledge management). Such practices may serve as an excellent empirical evidence to study the interaction between IPR management differences and innovation practices and their impact on the results of organization performance in subsequent studies.

Organizational Innovation Outcomes

The effects of these analyses of outputs of organizational innovation have been significant gains for organizations that benefited from the innovation across a set of performance measures. All the composite indices related to innovation performance, scaling up to the level of commercialisation of technologies, to business growth, to the competitive advantage and to the efficiency in managing knowledge had positive scores compared to the baseline scores as presented in Table 3. They were calculated on a percentage between the pre and post measuring days and allowed us to make comparisons by the dimensions of the outcome.

Table 3. Organizational innovation outcomes: percentage improvements across key indicators

Indicator	Improvement
Innovation Performance	+29.3%
Technology Commercialization	+25.7%
Business Growth	+22.8%
Competitive Advantage	+24.6%
Knowledge Management Efficiency	+26.4%

The organization with the greatest improvement (+29.3%) in the area of innovation performance cited was in the sample. Results show that there are positive links between extensive IPR management and improved innovation outputs like the creation of new products, process gains and innovations efficiency; likewise, the investments in R&D and digital innovation and knowledge management system were positively associated with improved innovation outputs. The enhancement is comparable with prior research works which found the correlation between strategic IPR management and innovation performance in KIICs (Davis, 2004).

Organizations' improvement in technology commercialization was 25.7%, demonstrating greater capacity to create the results of R&D expenditure and better use of the capacity of IPs to develop products and performances, and enter the market. This finding tallies with the theoretical approach that indicates that returns of innovation can be captured using a mechanism that can secure and commercialize (Teece, 2017) new technology, provided that effective IPR management exists. The growing number of technology commercializations also underline the growing significance of the role of digital platforms and ecosystems in boosting the commercialisation of research output (Acs et al., 2021).

Current IPR strategies also helped to achieve significant increases in competitive advantage with a 24.6% higher score for those that had a comprehensive approach that built their strategies. The above discovery provides an argument for why IP can provide firms with sustainable competitive advantage since others are hindered from imitating them and the firm can benefit from its own innovation (Davis, 2004). Finally, there was a 22.8% improvement in business expansion, which demonstrates how the strategic management of IP rights has been useful in business revenue expansion and increase in market share. This was the lowest of the five indicators, but still a significant positive development to highlight the economic importance of good IPR governance.

These outcomes of organizational innovation are motivating enough proof that the extent applying IPR management, combined with an approach to digital innovation and knowledge management system significantly positively affects on several aspects of organizational performance. The overall performance of the five indicators is good, with improvement in every dimension, suggesting that the

strategy for IPR management exceeds the short-term measures of innovations in terms of sourcing more general ICT competitive and growth dimensions. The next step involves regression and structural equation modeling that will explore the specific pathway(s) in which IPR management explains these performance outcomes.

Regression Analysis

A Multiple linear regression model analysis was conducted in order to determine the main sectors as drivers of innovation performance, use as dependent variable the Innovation performance index. The independent variables used were the Intellectual Property Management Index, R&D Investment, Digital Innovation Adoption Index and Knowledge Management Index. The regression model was statistically significant, and accounted for a significant amount of variance in innovation performance, (adjusted). The higher the percentage of variance explained the more impactful the key factors on innovation in the digital economy and the higher the key importance of the strategic factors on explaining built innovation outcomes.

The findings of all the four independent variables that were studied as the research variables in the study were significant positive predictors of innovation performance which was obtained from the results in Table 4. The standardized beta-coefficient to show the highest association was Intellectual Property Management Index (). The study results show a correlation between each SD in the score of the management comprehensiveness in intellectual property (with patent protection score, copyright management score, trademark strategy score and IP governance score respectively) and an improvement of 0.46 SD in the innovation performance variable after adjusting for other variables. These findings are consistent to those found in most previous research which has emphasised Strategic IPR management as being one of the pillars of a system for generating returns from innovation investment and for generating continual innovation (Davis, 2004).

Table 4. Multiple linear regression results predicting innovation performance

Predictor Variable	Standardized β	p-value
Intellectual Property Management	0.46	< 0.001
R&D Investment	0.41	< 0.001
Digital Innovation Adoption	0.35	< 0.001
Knowledge Management	0.30	0.002

R&D investment was the second most scoreful among seven characteristics insured, the standardized coefficient being (). All the characteristics of the process of innovation were confirmed directly, and there were not so many variables that required investigation. This is in line with the resource-based view of the firm, which holds that investments in foundation capabilities including research and development (R&D) play an important role in innovation and the maintenance of competitive advantage (Holgersson, 2012). This finding is further supported by the positive relationship previously mentioned, and these findings fit the theoretical work that indicated that firms with greater R&D expenditures are more apt to have new products, processes and services.

That same standardized coefficient (β) was the third major predictor – digital innovation adoption. In doing so, the discovery places the relevance of new digital technologies based, among others, on artificial intelligence, cloud computing, data analytics and platform business models in the field of innovation performance once again in its focus. Companies that explicitly incorporate the digital tools into their entire innovation process can better leverage data-driven insights, automate repetitive work, and adopt a distributed approach to cooperation in order to enhance and accelerate the nature of innovation (Acs et al., 2021). The need to increase the scope of innovation in the current business environment thus underscores the need to complement the existing IPR management based on the traditional approach with digital capabilities, as the adoption of digital innovation is a high impact.

The fourth important predictor was knowledge management, standardized (β). However, despite this, knowledge management still makes a significant contribution to this model, even if not quite as dynamic. This result is confirming the theoretical background, which suggests that the successful transfer of knowledge (seizing, codifying and dissemination of knowledge systems) boosts the ability to manage IPRs, since the IPRs will be more accessible for relevant IPR stakeholders and used in the innovation process. (Holgersson, 2012) The relevance of organizational learning mechanisms as a lever for realizing innovation outputs from IPR is also highlighted in the significant positive impact of knowledge management.

The regression findings that the model has a high persistence and all the regressors are positive and statistically significant offer strong empirical support for the positive impact of innovation performance in the digital economy on the strategic use of IPR management and investment in R&D, adoption of digital technology, and knowledge management mechanisms. Based on the size of the coefficients in the model, the latter two variables—ironically enough digital innovation adoption and knowledge management—have valuable complementary roles while the two variables of interest to this study—IP management and R&D investment—are the most influential. The findings are applicable to any organization aimed at boosting the success of their innovation work, pointing toward leaders being more focused on investing in IPR governance and R&D to gain a better return on their program, in addition to implementing in-house programs for digital transformation and knowledge management that can enhance innovation outcomes. The regression results will also be utilized in the next analyses phase where the data will be analyzed using structural equation modelling and will examine the causal relationship among the predictors on the one hand, and innovation performance, technology commercialization, competitive advantage, and business growth on the other.

Correlation Analysis

A Pearson correlation was used to analyze the bivariate relationships between the constructs of interest. Results indicated that there is a significant positive relationship between the Intellectual Property Management Index and the Innovation Performance Index meaning that the greater the extent of the organisation's usage of IP Management, the greater the organisation's innovation output. It is in line with theory which indicates the need to find room for innovation through the right combination of IPR, including the rights to return, mitigating the risk of the sharing of knowledge (Davis, 2004). The strength of this correlation (r) indicates a very strong linear relationship and could mean that the range of innovation performance of the sampled organisations is linearly related to the range of IPR management practices of the sampled organisations.

Additionally, there were also positive high correlations between the Intellectual Property Management Index and other organizational results. Specifically, a highly positive correlation was found between IPR management and technology commercialization, suggesting that stronger organizations in terms

of developing IPR strategies are more likely to be successful in putting the technology to use in marketable products and services. This outcome is in accordance with earlier studies who have pointed out the necessity of a legally secure playing field via IP rights for enterprises to monetise their innovations and to gain some legal edge during commercialisation (Teece, 2017). The same facts between the management of IP and the growth of businesses also obtained favorable and significant that is, strategic management of IP can be applied as the instruments in promoting the business growth particularly with regards to promoting the business share in the market. The discovery reinforces the notion that IPs are a source of long-term competitive advantage towards sustainable business growth (Davis, 2004).

This analysis shows some initial evidence for the interrelatedness of IPR management and some organizational performances based on the pattern of correlations observed. This suggests that the benefits of strategic IP governance do not only accrue through short term indicators of innovation but can also be used to effect more broadly benefit from commercial and competitive effectiveness gains. It is in line with the theory proposition that a comprehensive capability for IPR management is a core competency that benefits organisations in their pursuit of innovation, commercialisation and growth by capitalising on their IP assets (Holgersson, 2012). The outcome of the correlations also supports the next step which is the analysis of the performance outcomes of the research using the Structural Equation Modeling analysis that will be carried out to examine the direction of the paths after controlling the inter-relationship of the constructs in the examination of the path direction of the influence of IPR management on the examined performance outcomes.

Structural Equation Modeling

It was tested using a hypothesis of cause and effect between latent constructs obtained based on AMOS software, which is known as Structural Equation Modeling (SEM). First, the measurement model was validated using Confirmatory Factor Analysis (CFA), to get the factor loadings of every observed variable, with factor loadings of more than 0.70 and a significance level of less than 0.05. This validation made a valid representation because the indicators observed were enough to represent Intellectual Property Management (IPM), Innovation Performance (IP), Digital Innovation Adoption (DIA), Knowledge Management (KM) and Technology Commercialization (TC) fulfilling the criteria for estimating the structural model.

The model also derived direct relations between the Intellectual Property Management with the Innovation performance, and Technology Commercialization with the Business Growth, and indirect relations with the Knowledge Management and Adoption of Digital Innovation. The model covered a direct relationship between R&D Investment and Innovation Performance, as well as between R&D Investment and Technology Commercialization, which was congruent with the theoretically proposed direct connection between resource allocation on innovation activities and the result of the innovation activities comparing to other theories proposing an indirect relationship. The direct relationship between R&D Investment and Innovation Performance as well as R&D Investment and Technology Commercialization was included in the model, consistent with the idea of a direct linkage between resource allocation to R&D activities and the outcomes of R&D activities as presented in other theories. As detailed in Table 5, the overall model indices showed the goodness of fit of the hypothesized model and observed data were excellent.

Table 5. Structural equation model fit indices

Fit Index	Value	Recommended Threshold
Chi-square/df	2.04	< 3.00
Comparative Fit Index (CFI)	0.98	> 0.95
Tucker–Lewis Index (TLI)	0.97	> 0.95
Root Mean Square Error of Approximation (RMSEA)	0.043	< 0.06

A ratio of Chi-square/df of 2.04 was far below the recommended value of 3.00 suggesting that the difference between the observed and predicted covariance matrices was acceptably small, compared to model complexity. Both the Comparative Fit Index (CFI) = 0.98 and the Tucker–Lewis Index (TLI) = 0.97 were greater than 0.95, indicating a significant increase in the explained relationship among the variables measured with the hypothesized model compared to the null model. In addition the deviance (0.043) was less than the limit (0.06) for the RMSEA criterion, suggesting a good fit with the covariance matrix of the population of interest and very little error of approximation in the relationships represented in the model. All the results of these fit indices together show that the structural model is a very good fit, which validates the postulated causal pathways.

Results of SEM indicate apparent direct effects of Intellectual Property Management on Innovation Performance and Technology Commercialization and Business Growth that suggests comprehensive IPR governance has multiple impacts on the organizations' performance. For indirect effects, the 2nd indirect one was the construction of Knowledge Management which predicted significantly Innovation Performance (via Innovation Performance) and Technology Commercialization (via Innovation Performance). One such pathway in IPR management is systematic knowledge capture and sharing that brings tangible outcomes of innovation and commercialisation, as will be discussed here and throughout the report (Holgersson, 2012). Based on the SEM results, the proposed integrated framework in this research can then be supported through empirical evidence, namely the integrated framework of Innovation and Competitiveness in digital economy has a direct relation with IPRM and indirect relation of the integrated framework of KM with TM.

Comparative Findings

A comparative study of organisations with complete IPR strategies and those operating without a fully developed IPR management concept was undertaken, as part of the process for further supporting the benefits of good IPR Management. Table 6 presents results of comparing the performance of organizations that have strategically managed intellectual property (IP) assets with those that haven't. The findings show that IP strategy has substantial and stable positive effects on multiple measures of performance, across a range of organizations.

Table 6. Comparative performance advantages of organizations with comprehensive IPR strategies versus those with limited practices

Performance Indicator	Percentage Advantage
Innovation Performance	29.3%
Knowledge Management Efficiency	26.4%
Technology Commercialization	25.7%
Competitive Advantage	24.6%

Performance Indicator	Percentage Advantage
Business Growth	22.8%

It was found that companies that have a long history of IPR, performed 29.3% better in innovation performance than companies with a short history of IPR. As part of this significant benefit, it implies that strategic governance of IP rights is vital for an investment climate for innovation, which will bring the legal and organizational framework to incentivize innovation entry in new product development from R&D investments (Davis, 2004). The size of the difference is not an incremental but rather an enabling difference to drive the innovation level in the digital economy through IPR management.

Furthermore, it was found that companies that employed good IPR strategies scored 38.4% highest in KM efficiency. As the discovery herein has revealed the IP governance as a systematic way of managing IP advances the knowledge management system (Holgersson, 2012) by being able to capture, codify and share knowledge assets more effectively across an organisation. There may be more formal documentation and protection of intellectual property, and this may be the reason for the increased knowledge management efficiency observed in these organisations, as they have the ability to reuse and draw on knowledge for innovations.

The comparison was additionally revealing as it demonstrated a 25.7% boost in technology commercialization for those with a complete and strong IPR strategy. Therefore, this outcome is generally consistent with theoretical view attributing the successful IPR management to granting legal exclusivity which enable firms to monetise their innovation (Teece, 2017). The percentages of technology commercialization in these organizations indicate that strategic IPR governance is an enabler for protection of IPR, but also promotes commercializing it to commercial successes.

Rating for organizations that had an IPR strategy were 24.6% higher than those without a strategy. Strategic IP Management is a driver for improved market positioning. The result is in tandem with the perception that IP assets provide sources of sustainable competitive advantages in and to the market because of the imitation constraint and that the capacity of the firm to differentiate in the market via IP assets is pervasive (Davis 2004). This competitive position gap could be linked to the organisations ability to leverage this IP to capture market share, create brand awareness and become technological leaders.

The comparative results indicate evidence in law to support this: a strong framework of IP rights is an important enabler of innovation and competitiveness in the digital economy. The clear trend of gains for each of the five performance indicators (innovation performance, knowledge management efficiency, technology commercialization, competitive advantage, and business growth) demonstrates the compounding power and range of benefits of strategic IPR governance. A solid IPR program, coupled with generative patent resources, extension of copyright protection and the establishment of formal IP policies as well as registering and owning trademarks provides a strategic advantage with a positive impact throughout the value chain of innovation, as well as core business metrics. These findings have a number of implications for organizational leaders and policy makers, especially in digitalized markets: IP management is becoming one of the key skills for success.

Discussion

The results could have implications for theory and practice in how the management of IP rights can help companies innovate and secure a competitive edge in the digital economy. Our results theory-typically are related to the resource based view of the firm as they empirically test its hypotheses: “IP is a valuable

resource, it is rare and hard to imitate, and it can offer sustainable competitive advantage” (Davis, 2004). The result for strong direct effects of IPR management ($\beta = 0.46$) and the excellent values of CFI (0.98) RMSEA (0.043) confirm the integration of an innovation management system as a starting competency in business performance before the company with investment in innovation systems. Furthermore, the mediation with which the knowledge management process of IPR and innovation are intertwined, can be associated with the numerous writings, related to the concept of “Dynamic Capabilities”. This ability to systematically capture, code and utilize intellectual assets is an important element of how IPR management can be expressed as innovation outcomes (Holgersson, 2012). This finding undermines the “historically” accepted view of the scope of IPR as being only a legal protection tool and reinforces the idea that it is instead an integral component of that organisation's knowledge management systems architecture as a cross-cutting tool.

From a practical point of view, the findings provide practical directions for organizational leaders and policymakers looking to maximize the performance of their companies' innovation activities in increasingly digital markets. The high explanatory power ($R^2 = 0.758$) indicates that all the four factors affect the high part of the innovation outcomes variance; they can be used concurrently to explain the variance. For practitioners, this indicates that comprehensive innovation management is the key to innovation – it is not possible to only focus on R&D investments and digital transformation, but also combine them with solid IPR governance to make the best of investments. In particular, the positive relationship between a thorough level of IPR and higher levels of innovation performance (29.3%) and higher numbers of technology commercialisation (25.7%) reported by companies with comprehensive IPR shows the economic contribution of companies that have a comprehensive IP policy, systematic handling of copyright and trademark, and proactive patent filing. The results will be useful for policy makers for empirical basis to take decisions for policy measures to incentivize SMEs to develop IPR competencies like better disburdenment of tax break on R&D whose outcome will be a registered IP, or reducing fee for filing a patent, or providing training on IP awareness. Additionally, its high Competitive Advantage (24.6%) grounded in the comprehensive IPR strategies make it even more important to invest in IPRs promotion and enforcement via A NISS, particularly in the digital field where the likelihood of imitation is significant (Acs et al., 2021).

The results were found to be good, although there were some limitations to the methods used. Participants should note: The cross sectional study design does not allow causal inferences, and the relationships between the characteristics of IPR management and the results in the form of innovation performance can be one-way and multi-way. In the end, there may be an opportunity for this innovation to be stimulated: If, e.g. innovation level would be higher, the company might be more willing to invest in IPR management, although innovation does not result in IPR management. They are self-reported data which limits the data to not being purely observed but is somewhat mitigated by the use of secondary data supplied by the IP offices and corporate annual reports. Additionally, no detailed information is provided of the nature of the sample; it consisted mainly of technology companies and manufacturing companies and therefore the results are not directly transferable to other industries with specific IPRs issues (e.g. creative industry, health care). Previous studies identified ‘informal IPR strategy’ to be important in some contexts (complementary sales and services links, ‘lead time’ advantage, and ‘trade secret’) but were beyond the scope of this study. Moreover, an overall measure of digital innovation adoption as an index might not reflect the complex nature of the relationship between digital technologies and the various practices as part of IPR management (e.g., AI, blockchain, IoT).

These constraints suggest some potential avenues of further investigation. Longitudinal studies of organizations over time to establish temporal order of investments in IPR management and outputs of innovations to bolster causal inferences would be desired. Future research could focus on the moderating conditions that may influence the link between IPR and innovation, such as the differences in the IPR–innovation relationship found across various industry types featuring diverse appropriability regimes, technological dynamism and regulatory settings. In contrast, the strategic importance of patent portfolios varies greatly across different fields of industry, for example, in pharmaceuticals and semiconductors, but far less in more so-called “digital platform” industries with greater network effects and first-mover benefits (Acs et al. 2021). Another lowly researched area is open innovation and collaborative management of IPR where two or more organizations share IPR using different modes of collaboration, cooperation and sharing, primarily through licensing, cross-licensing and patent pools to promote innovation. It was addressed in this study to the situation of the protection action from inside the IPR management framework, pointing towards the new IPR trends in the era of digital economy which call for a hybrid IPR protection action - in the form of various types of protection *öffnungsmodi* versus openness. Last but not least, analysis of relationships between new technologies including artificial intelligence and blockchain and new challenges in terms of authorship, ownership and enforcement of IPR is needed. Finally, comparisons with the divergent national IPR-regimes and cultural contexts to highlight the impact of legal and institutional contexts on the efficiency of IPR-management practices and how this context has to be locally adapted to make IPR-policies globally coherent while being locally adaptive would be helpful.

Conclusion

The purpose of this study is to gain understanding of the impact of IPR on the organizational innovation results, competitiveness and business development in a digital economy with regard to digital innovation approach and the knowledge management approach. We analysed quantitative data from 981 respondents from 180 organisations to deliver solid data that comprehensive IPR management is a key enabler of innovation and sustainable competitive advantage. The results show that correct choice of patent strategy, trademark strategy, copyright strategy and R&D investments coupled with digital innovation adoption and systematic knowledge management – can result in significant performance gains in a number of performance dimensions. Those who had strong IPR practices experienced 24.6% higher competitive advantage; 25.7% higher innovation performance; and 29.3% higher technology commercialization than those with weak IPR practices. Overall the proposed structural equation model is able to achieve the desired success, which provides justification for the idea of integration that we have formulated and the results show the immediate impact as well as indirect impact via Knowledge Management. In contrast to a prevailing trend of only considering the legal dimensions of IP, this research brings additional quantified evidence to the analysis of the specific role played by the synergy of three factors (IPR governance, digital transformation, KM) on the innovation-driven growth of digital markets.

This study has some possible lines of inquiry for the future. To make inferences about the causal direction of the relationships, the relationship between the changes and the IPR management capabilities over time should be observed, which requires an organization to be using a longitudinal design. The nexus between the IP and the Innovation should also be investigated in other industries and sectors of economy with specific types of appropriability regimes where the formal IP mechanisms and informal IP protection (such as ‘trade secret’ and ‘lead time’ advantage) have different interactions. Some sectors that may be of interest are the creative industry, health and life science and agriculture. New technologies, including AI and blockchain bear with them new questions and issues concerning

authorship, ownership and enforcement, making them particularly relevant in the scope of IPR issues to intersect IPR management and emerging technologies. In addition, comparative studies of the national IPR regimes, and cultural environments, would bring new insights and feed into the process of designing the culturally adequate, but institutionally coherent and effective innovation policy. The question of balancing open-class IP protection with openness will be a hot topic in research and practice for the foreseeable future in the digital economy.

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