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ARTICLE

FROM HYBRID INCENTIVE SYSTEMS TO COMPETITIVE INTELLIGENCE: HOW KEY TECHNOLOGIES ENABLE INNOVATION MANAGEMENT IN MULTI-AGE TEAMS

DE SISTEMAS DE INCENTIVOS HÍBRIDOS À INTELIGÊNCIA COMPETITIVA: COMO TECNOLOGIAS-CHAVE VIABILIZAM A GESTÃO DA INOVAÇÃO EM EQUIPES MULTIGERACIONAIS

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ABSTRACT

Purpose: This study investigates how hybrid incentive systems and key digital technologies foster competitive intelligence capability and how this capability drives innovation management in multi-age teams within technology-intensive organizations.

Methodology/approach: A quantitative survey was conducted with 387 employees from Chinese technology-intensive firms. Structural Equation Modeling (SEM) was applied to test direct, mediating, and moderating relationships among hybrid incentive systems, digital technologies, competitive intelligence capability, innovation outcomes, and generational diversity.

Originality/Relevance: The study advances competitive intelligence research by positioning CI as the central strategic capability that transforms socio-technical inputs into innovation outcomes, moving beyond technology-centric or HR-based explanations of innovation performance.

Key findings: Results show that hybrid incentive systems significantly enhance innovation outcomes, with digital technologies partially mediating this relationship. Competitive intelligence capability exhibits the strongest direct effect on innovation performance. Generational diversity positively moderates the incentive–innovation relationship, strengthening results in highly diverse teams.

Theoretical/methodological contributions: The research integrates human resource systems, digital transformation, and competitive intelligence into a unified framework, demonstrating CI as a dynamic, information-based capability that converts incentives and technologies into sustainable innovation. Methodologically, it provides empirical evidence using SEM in a multigenerational context, contributing to intelligence-based decision-making and innovation strategy literature.

Keywords: Competitive intelligence capability. Hybrid incentive systems. Digital Technologies. Innovation management. Generational diversity. China.

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RESUMO

Objetivo: Este estudo analisa como sistemas híbridos de incentivos e tecnologias digitais fortalecem a capacidade de inteligência competitiva e como essa capacidade impulsiona a gestão da inovação em equipes multigeracionais em organizações intensivas em tecnologia.

Metodologia/abordagem: Foi realizado um survey quantitativo com 387 colaboradores de empresas chinesas intensivas em tecnologia. Utilizou-se Modelagem de Equações Estruturais (SEM) para testar relações diretas, mediações e moderações entre incentivos híbridos, tecnologias digitais, inteligência competitiva, resultados de inovação e diversidade geracional.

Originalidade/Relevância: O artigo reposiciona a inteligência competitiva como capability estratégica central, superando abordagens centradas apenas em tecnologia ou gestão de pessoas e evidenciando seu papel na transformação de insumos organizacionais em desempenho inovador.

Principais achados: Os sistemas híbridos de incentivos impactam positivamente a inovação, com mediação parcial das tecnologias digitais. A inteligência competitiva apresenta o efeito direto mais forte sobre os resultados inovadores. A diversidade geracional intensifica a relação entre incentivos e inovação.

Contribuições teóricas/metodológicas: O estudo integra incentivos, transformação digital e inteligência competitiva em um framework único, demonstrando a CI como mecanismo decisório baseado em informação. Metodologicamente, oferece evidências empíricas em contexto multigeracional, contribuindo para a literatura sobre inovação orientada por inteligência.

Palavras-chave: Capacidade de inteligência competitiva. Sistemas híbridos de incentivos. Tecnologias digitais. Gestão da inovação. Diversidade geracional. China.

1. INTRODUCTION

Innovation has now assumed a pivotal strategic direction of organizations that are functioning in a rather dynamic, technologically charged, and knowledge intensive oriented environment. Modern organizations are under the pressure of technology change that is speeding up, heightened competition at the global level and swiftly changing customer demands that all require sustained innovation in products, services, processes and business models. In this regard, innovation management has become one of the important organizational capabilities that help firms to generate, evaluate and implement new ideas in a systematic manner to maintain a competitive advantage (Adedoyin Tolulope Oyewole et al., 2024). Nevertheless, technological investments, research and development activities are not the only sources of innovation, innovation is also heavily influenced by organizational systems and human resource practices as well as digital infrastructures that support knowledge creation and exploitation.

Incentive system design is one of the greatest organizational mechanisms influencing the outcomes of innovation. Rewards systems affect the intelligence participation of employees, their engagement, and discretionary effort which promotes creativity and innovative action. Financial rewards, in the form of bonuses, salary increments, profit-sharing scheme, have been the main prospects of conventional incentive programs. Nonetheless, modern organizations have been moving towards hybrid incentive systems, which combine both financial and non-financial incentives, such as recognition schemes, career development, flexible working and autonomy-supportive practices (Pique et al., 2019). Hybrid incentive schemes are especially applicable in knowledge-based situations where intrinsic intelligence participation and psychological empowerment have significant roles in the intelligence participation of innovative actions. The relationship between hybrid incentive systems and digital technologies in determining the outcome of innovation management is not adequately covered in empirical studies, although the topic is essential.

At the same time, the digital transformation has changed the core challenges of the way organizations handle innovation and competitive intelligence. Core digital technologies including artificial intelligence, analytics of big data, cloud computing, intelligence infrastructure platforms and enterprise social networks will allow organizations to gather, process, and share knowledge at scale and velocity never seen before. These technologies aid real time working together, virtual working together, and data-driven decision making, thus, improving the organizational learning process and innovation. In addition, with the help of digital technologies, it is easier to conduct an organized purchase and analysis of market and competitor information (Suh & Kim, 2025), which enhances the competitive intelligence of organizations. Competitive intelligence is defined as the organized process of receiving, examining and employing data concerning the rivals, customers and technological trends to aid in strategic choice and progress. With the growing dependence of organizations on digital infrastructures as the source of strategic sensing and innovation, the joint impact of incentive systems and technologies on the competitive intelligence and innovation outcomes is becoming one of the key concerns of

research.

The other key organizational trend that is defining innovation management is the rising multigenerational or multi-age team. The modern organizational environment has a multigenerational workforce that includes various generations, and it is generally divided into Generation X, Millennials, and Generation Z. These generations vary in their values and expectations, work expectations, technological skills and intelligence participation. This is because the generation diversity might become a source of creativity and heterogeneity of knowledge which improves the levels of innovation (Katyayani Pandey et al., 2025). Nevertheless, it may also bring with itself issues of communication, co-operation and incentive compatibility. Digital technologies and hybrid incentive systems can be importantly relevant in the process of overcoming the intergenerational gap through offering flexible intelligence participation frameworks and technology-based collaboration systems. However, there is less empirical research on the influence of multi-age composition of teams on the efficiency of incentives of system and digital technologies in the management of innovations especially in the emerging economies.

Group relations in China are a good empirical backdrop to study these relationships. China is one of the largest and most quickly digitizing economies in the world, which has spent much money on digital technologies, infrastructure of innovations, and development of human capital. Chinese companies are growing in total number of generations and have elaborate systems of incentives to enhance innovation and competitiveness (Mariani & Dwivedi, 2024). In addition, the strategic focus on technological innovation and digital transformation in China has enhanced the necessity to adopt competitive intelligence systems to navigate the global competition and technological disruption. Although such developments are of strategic significance, there is paucity of academic studies that combine hybrid incentive systems, key digital technologies, multigenerational team dynamics, and competitive intelligence in a single system of innovation management.

The current body of research on innovation management has to a great extent considered incentive systems, digital technologies, and competitive intelligence as isolated studies. Research on incentives systems has concentrated on non-financial and financial incentives and their impact on intelligence participation and performance of employees. Studies on digital transformation have examined the ways in which digital technologies help an organization to innovate and transform into digital business models. The literature on competitive intelligence has focused on information gathering, analysis and strategic application as a way of gaining competitive advantage. Nonetheless, not many studies have empirically merged these areas to describe how hybrid incentive systems and digital technologies in combination facilitate innovation management and competitive intelligence in multigenerational organizational settings. Also, the majority of the empirical research has been carried out in the Western environment which inhibits the use of the results to the developing economies like China.

In order to solve these gaps, the proposed study hypothesizes a combined framework that includes the connection between hybrid incentive systems, major digital technologies, results of innovation management, and competitive intelligence capability within multi-age teams. Specifically, the research analyzes (1) the direct impact of hybrid incentive systems on the outcomes of innovation management, (2) the mediating presence

of the key digital technology in the association between incentive systems and innovation results, (3) the impact of competitive intelligence capability on innovation management outcomes and (4) the mediating presence of the generational diversity in multi-age teams. The proposed study will offer a comprehensive insight into how organizations can develop incentive-technology architecture to achieve innovation in varying workforce environment by incorporating the human resource management, digital transformation and competitive intelligence perspective.

The input of this research is three-fold. First, it supports the theory of innovation management by systematizing hybrid incentive systems and digital technologies into a single empirical model which will explain the results of innovation and competitive intelligence. Second, it provides an expansion of the existing body of literature on competitive intelligence by empirically connecting the innovation management processes with the competitive intelligence capability, which is enabled by digital technologies (Deng et al., 2026). Third, it is a contribution to the body of work on generational diversity and workforce management by investigating the role of multi-age team composition in moderating the role of incentive systems in the context of innovation. Considering practical implications, the findings give practical implications of use among managers and policy makers in the designing of incentive structures and digital infrastructures with the view of increasing innovation and competitive intelligence in organizations within digitally transformation atmosphere. This paper postulates that the innovation is not affected directly by the hybrid incentive systems and digital technologies. Rather, they facilitate organization ability to collect, analyze, disseminate and utilize competitive intelligence in a systematic manner. This competitive intelligence ability emerges as the driving force that changes technological and intelligence participational inputs into innovation outputs and sustainable competitive advantage in multigenerational teams. Thus, competitive intelligence is not presented as a marginal result in this research, but rather as a core strategic capability in terms of which the innovation is achieved. Thus, this paper locates the competitive intelligence capacity as the focal point in which hybrid incentive systems and digital technologies can affect the innovation performance in multigenerational groups.

In that regard, the following research questions will be considered in the current study: (1) What is the impact of hybrid incentive systems on the outcomes of innovation management in organizations? (2) What are the ways in which important digital technologies mediate the relationship between incentive systems and innovation outcomes? (3) What is the role of competitive intelligence capability in shaping innovation management outcomes? and (4) What role does generational diversity in multi-age team play in mediating such relationships? It is hoped that this research will add to theoretical insights and be an evidence-based guideline on how to implement innovation-based organizational strategies by further investigating these questions through an empirical study of the Chinese organizational environment.

2. LITERATURE REVIEW

2.1 Competitive Intelligence as a Strategic Capability

Competitive intelligence (CI) is not the act of collecting market information, and it is an organized activity of an organization that entails the systematic process of information acquisition, analysis, interpretation, sharing, and strategic application in making decisions. The theoretical approach of classical CI literature models the notion of intelligence as a continuous cycle which minimizes the uncertainty, improves strategic sensing, and facilitates a competitive advantage through informed decision making (Tajeddini et al., 2026).

CI is an active ability that allows companies to feel the environment and read the signs of competitors, as well as adjust their sources in response. This intelligence cycle involves (1) gathering information of competitors, markets and technologies, (2) analytical interpretation of signals, (3) spreading information to decision units and (4) using the information in strategic and innovation-oriented decisions (Almajali et al., 2025).

AI, analytics, and collaboration tools are examples of technologies that serve as intelligence infrastructures in digitally transformed organizations, and the incentive programs encourage employees to engage in intelligence operations, like sharing knowledge, interpreting it, and reporting. Thus, the concept of hybrid incentive systems and digital technologies can be perceived as the precursors that facilitate the creation of competitive intelligence capability that, in its turn, will lead to innovation outcomes (Wu et al., 2023).

2.2 Innovation Management and Organizational Competitiveness

Innovation management can be defined as the process in which organizations create, choose, deploy, and spread new ideas, products, services, and processes in a systematic way. It is well known to be one of the major organizational competitiveness and long-term performance determiners. Innovation management literature points to the fact that innovation is not spontaneous, but is a product of organized organizational processes, such as strategic leadership (Mashau et al., 2025), knowledge management systems, human resource systems, and technological infrastructures. According to the dynamic capability's theory, organizations have to keep sensing, seizing, and reconfiguring resources to adapt to environmental change, and innovation management is one of the fundamental expressions of these capabilities.

Strategically, innovation management helps in the achievement of incremental and radical innovation, which helps firms to increase their efficiency in operations, differentiate their products and venture in the new market. Innovation in knowledge-based economies is more intangible due to the focus on human capital, organizational culture, and digital capabilities as the sources of an innovation. This has led to the organizational processes that drive innovative behaviour and creation of knowledge as a prime research agenda in the management and organizational studies.

2.3 Employee innovation and Hybrid Incentive Systems

Incentive system is a basic tool in an organization which is employed to align the behavior of employees with the organizational objective. The agency theory assumes that incentive systems minimize the incongruence of goals between the principal and the agent through a system of reward based on performance. Traditional incentive programs have been more inclined towards extrinsic rewards such as financial compensation, bonuses and profit sharing (Rahma et al., 2025). Nonetheless, the behavioral and psychological literature implies that extrinsic incentives can replace intrinsic intelligence participation on their own, especially in the processes that are creative and information-intensive.

Hybrid reward systems combine extrinsic and intrinsic intelligence participational procedures involving the use of both financial incentives and non-financial incentives including recognition, autonomy, career growth, flexible work plans, and learning. The Self- Determination Theory (SDT) emphasizes the role that autonomy, competence, and relatedness play in promoting intrinsic intelligence participation and intrinsic creativity. These psychological needs can be addressed by use of hybrid incentive systems that in addition offer tangible performance-based rewards, hence the establishment of a balanced intelligence participational architecture (Leonidou et al., 2025).

The empirical studies have shown that employee engagement, creativity, and performance in terms of innovation are positively related to hybrid incentive systems. It has been discovered that non-financial incentives like empowerment, feedback, and professional development arouse an exploratory behavior and knowledge sharing whereas financial incentives reinforce the goal alignment and intensity of effort. Nonetheless, hybrid incentive systems might be effective depending on cultural or contextual conditions, such as organizational culture, characteristics of tasks, and workforce diversity. Although it is gaining interest, there is limited literature on how hybrid incentive systems can be used together with digital technologies to determine the outcomes of innovation management.

2.4 Significant Digital technologies and the facilitation of innovation

Digital transformation has transformed the organizational processes, structure, and capabilities. Artificial intelligence (AI), big data analytics, cloud computing, intelligence infrastructure platforms, and enterprise social networks are the most important digital technologies that facilitate innovation management. Technology-Organization-Environment (TOE) framework and the Resource-Based View (RBV) hypotheses also imply that digital technologies are the strategic resources contributing to the organizational capabilities and competitive advantage (Fadhlurrahman et al., 2024).

AI and big data analytics make organizations access the insights of large and complex datasets, which facilitate the use of data-driven innovation and predictive decision-making. Intelligence infrastructure systems enable virtual collaboration, transfer of knowledge and cross-functional collaboration that are critical in encouraging innovation in geographically diverse and dispersed teams. Cloud computing offers scalability in experimentation and introduction of innovative solutions. Combined, such technologies

form a digital ecosystem that facilitates the ongoing innovation cycles.

Digital technologies also contribute to the improvement of the absorptive capacity as they help organizations obtain, integrate, synthesize and utilize external knowledge. Organizations can commercialize faster by using digital tools to enhance the processes of generating ideas, developing prototypes and commercializing them. Nevertheless, the introduction and successful implementation of the digital technologies are conditional upon the organizational intelligence participations, staff intelligence participation, and human resource policies. Thus, the interaction between incentive systems and digital technologies is the area, which should be considered to understand the management of innovation in modern organizations.

2.5 Capability in Competitive Intelligence

Competitive intelligence (CI) is the process of gathering, analyzing, and sharing information regarding competitors, customers, markets, and other technological trends in an organized and ethical way to drive strategic decisions. CI is an essential element of strategic management, as it allows companies to predict the market, determine the opportunities and threats, and direct the innovation strategies. The CI process generally involves the acquisition of information, analysis, interpretation and communication to the decision makers.

Digital technologies have changed the way of competitive intelligence practices, automating the collection of data, allowing to monitor the competitor and the market in real-time, and advanced analytics. AI-driven and big data analytics can establish trends and patterns that can be used as a guide to innovation and strategic planning. The digital platforms also make it easier to combine both internal and external sources of knowledge and increase organizational learning and intelligence (Maluleka & Chummun, 2023).

Competitive intelligence and innovation management have very close relation. CI gives strategic information on the focus of innovation, whereas innovation processes yield new knowledge which is integrated into CI systems. Nevertheless, there is a lack of empirical studies that can be used to study the causal relationship between innovation management and CI capability. Moreover, the influence of incentive systems and digital technologies on the development of the CI capability has not been delved into adequately, especially when it comes to multi-age team situations.

2.6 Multi-Age Teams and Generational Diversity

Multi-age or multigenerational teams are made up of employees belonging to various cohorts or generations and are usually classified into the following categories as Baby Boomers, Generation X, Millennials, and Generation z. Generational cohort theory proposes that people born during the same time share similar experiences leading to the development of values, attitudes, and behavior. These intergenerational variations have an impact on work preferences, adoption of technology, style of communication as well as intelligence participational drivers.

Generational diversity may also lead to creativity and innovativeness on the part of

the team by introducing different perspectives, knowledge bases and problem-solving methods. Heterogeneous teams have increased chances of coming up with new ideas and breaking the status quo. Nonetheless, the generational diversity may also pose a challenge of coordination, communication and conflicts based on divergence in expectations and working styles. Thus, the key to successful management of multi-age teams is the flexible incentive system and the collaboration mechanism based on technologies (Olaleye et al., 2024).

The digital technologies have the potential to address the differences between generations by presenting a standard communication platform and enabling sharing the knowledge between the generations. On the same note, the hybrid incentive systems would be in position to support different intelligence participational tastes by providing non-financial and financial incentives. However, there is limited empirical data regarding the effectiveness of incentive system and digital technologies in innovation management moderated by generational diversity. This gap is addressed by this study which identifies multi-age team composition as a moderating variable.

2.7 Harnessing Incentive Systems, Digital Technologies and Competitive Intelligence

The combination of the incentive systems and digital technologies is a critical yet understudied aspect of the innovation management. Hybrid incentive systems determine the employee intelligence participation to do the activities in the field of innovation, and digital technologies offer tools and platforms that are needed to collaborate, experiment, and share knowledge in the field. These components constitute a socio-technical system, which facilitates the process of organizational innovation and competitive intelligence (Golshan et al., 2025).

According to the socio-technical systems theory, the social systems (i.e., incentives, culture, leadership) interplay with technical systems (i.e., digital technologies, infrastructure) to produce organizational results. Using this viewpoint on innovation management implies that neither the incentives nor technologies are enough but the match between them defines innovation effectiveness. The ability to think competitively arises due to this alignment because motivated employees apply digital tools to collect, analyse and transfer strategic information.

2.8 Hypotheses Development

According to the theoretical overview, the following hypotheses are formulated in the course of the study:

H1: Hybrid incentive systems have a positive impact on the deliverables of innovation management.

H2: The key digital technologies are the mediating force between the hybrid incentive systems and the innovation management results.

H2a: Competitive intelligence capability mediates the relationship between key digital technologies and innovation management outcomes.

H3: Competitive intelligence capability has a positive impact on innovation

management outcomes.

H4: Generational diversity in multi-age teams mediates the correlation between hybrid incentives system and innovation management findings, whereby the correlation is more in highly diverse teams.

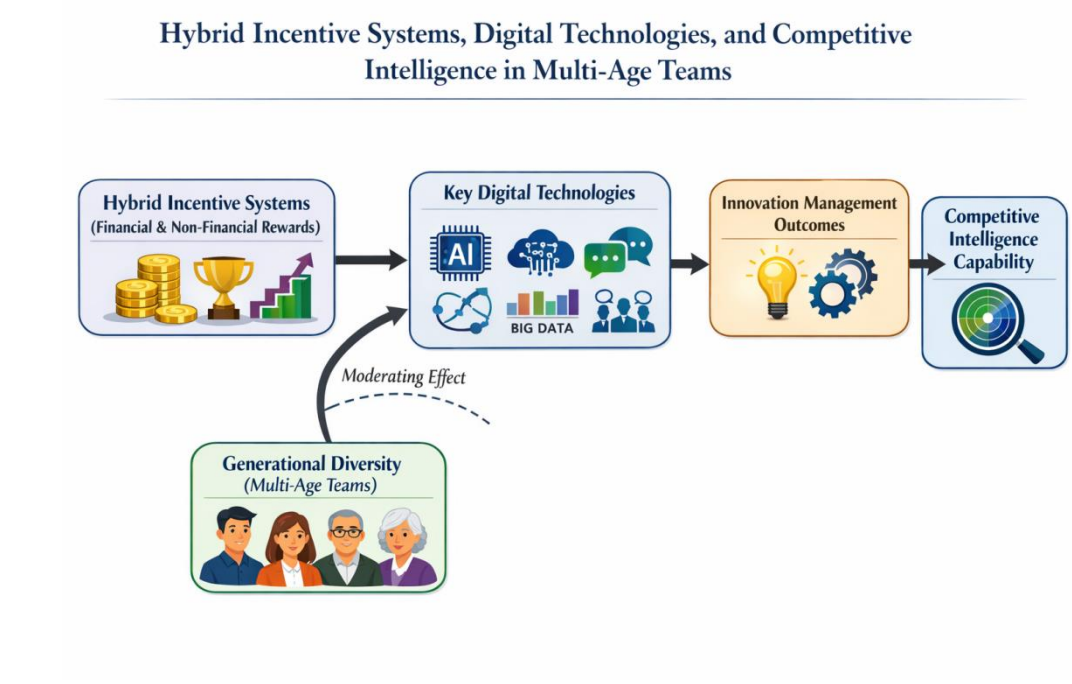

Figure 1. Conceptual Framework Diagram

This combined framework gives a thorough (Figure 1) theoretical foundation on investigating how organizations can hybrid incentive-technology frameworks to spur innovation management and competitive intelligence in teams of multi-ages. Figure 1 is also cycle that integrates the competitive intelligence cycle where the hybrid incentive systems and digital technologies are the antecedents to enable the information-gathering, analysis, distribution, and strategic implementation that leads to the innovation results and competitive advantage.

3 METHOD

3.1 Research Design and Theoretical Model

The research design adopted in this study is a quantitative, theory-based, cross-sectional study as it attempts to empirically support the proposed integrated framework between hybrid incentive systems, significant digital technologies, innovation management deliverables, and competitive intelligence capability in multi-age teams. A deductive method was used in which hypotheses were formulated by using existing theories and tested by survey data and multivariate statistical models (Kiani Mavi et al., 2019).

As the main analytical method, Structural Equation Modeling (SEM) was chosen due to its ability to model both measurement and structural models at the same time and the test of complex mediation and moderation relationships. The research model will involve (1) the direct impacts of hybrid incentive systems on the outcomes of innovation management, (2) the indirect impacts of hybrid incentive systems through the key digital technologies, (3) the downstream effects of competitive intelligence capability on innovation management outcomes, and (4) the moderating impacts of generational diversity.

3.2 Research Context and Organizational Setting

The empirical setting of the study is China, which can be discussed as a strategically important setting, because of its fast digitalization, state-based innovation policies, as well as the heterogeneous structure of the workforce. Chinese organizations are making active use of modern digital technologies, including artificial intelligence, big data analytics, and cloud-based collaboration tools (Reckziegel, 2025), which makes them a proper venue to study the concept of technology-enabled innovation management. In addition, the labor force population of China has several age groups formed by various generations that possess different technological and intelligence participation characteristics, and it is an inherent environment to examine the dynamics of multi-age teams.

The organizations were chosen in the fields that were technology-intensive, such as manufacturing, information technology services, digital platforms, and knowledge-intensive business services. These industries have been selected as they are considered to have the high intensity of innovation and the need of digital technologies in the process of knowledge production and development of competitive intelligence.

3.3 Procedure and Justification of the Sampling.

The multi-stage sampling process was done. The identification of organizations involved in digital transformation efforts was done in the first stage using industry reports, professional networks, and innovation clusters. The second step implied the invitation of employees engaged in the process of innovation-related activities (e.g., R&D, IT, marketing, operations, and management) to take part in the survey (Calof, 2025).

To provide a multi-generational representation of teams, the respondents were generalized into three generational cohorts according to the year of birth: Generation X (1965-1980), Millennials (1981-1996), and Generation Z (1997 and onwards). The level of team-level generational diversity was determined through the Blau index which measures the distribution of age groups within teams and is considered to be a moderator variable.

The questionnaires comprised 450 copies which were administered through online surveys and organizational contacts. Data screening resulted in the retention of 387 valid responses, which gave an effective response rate of about 86. The sample size is larger than the recommended size requirements of SEM (at least 200 cases or 10 times the number of free parameters) and would offer adequate statistical power (>0.80) in detecting medium effect sizes in mediation and moderation results.

3.4 Development of Measurement Instrument.

Multi-item reflective scales were used to measure all the constructs and were based on previous studies that have been validated in human resource management, digital transformation, innovation management, and competitive intelligence. The measurement of items was based on five-point Likert scale (1 = strongly disagree, 5 strongly agree).

Hybrid Incentive Systems (HIS): Scale Measured by items that represent both financial incentives (e.g., performance-based bonuses, profit sharing, stock options) and non-financial incentives (e.g., recognition, autonomy, career development, flexible working arrangements). Some examples of sample items are; "My organization offers performance based financial rewards to innovative ideas and employees are notified and rewarded to contribute to innovative ideas in the organization (Shi et al., 2021).

Key Digital Technologies (KDT): Scale measured with the items that determine the level of adoption and the successful usage of AI, big data analytics, cloud computing, and intelligence infrastructure platforms. Sample questions are: "In our organization, data analytics tools are used to make innovation decisions and Intelligence infrastructure platforms help in sharing knowledge among teams.

Innovation Management Outcomes (IMO): These are evaluated in terms of indicators of intelligence-enabled innovation which include idea generation, innovation implementation, process innovation, and product/service innovation. The sample items are: "Our organization is active in developing new ideas in products or services and innovative ideas are successfully put in practice (Qian et al., 2024).

Competitive Intelligence Capability (CIC): This is measured on a multidimensional scale that entails the acquisition, analysis, and utilization of information. Examples are, 1) Our organization gathers information about competitors in a systematic manner, and 2) Competitive information is used to make strategic decisions.

Generational Diversity (GD): Measured based on categorical cohort data and diversities index based on Blau at the team level. The structural model was tested by using this index to test the moderation effects.

3.5 Questionnaire Design, Translation and Pilot Testing.

The questionnaire was first created in English and translated into Chinese through a strict back-translation process in order to guarantee semantic and conceptual similarity. The questionnaire was translated to Chinese by two bilingual experts and it was later translated back into English by a third expert. The differences were addressed by consensus discussions.

A pilot test involving 30 respondents of Chinese organizations was used to test clarity, content validity as well as reliability. Following the suggestions of pilots, some wording changes were implemented in order to enhance the understanding and cultural relatability.

3.6 Data collection procedure and ethical issues.

The data were gathered within three months on online survey systems and direct contacts within the organizations. The participation was not obligatory, and the respondents were aware that the work was academically related. They were assured of anonymity and confidentiality and no personally identifiable information was obtained. All the participants have been informed of their consent. The research protocol was considered, and an institutional research ethics committee reviewed it and approved it based on social science research guidelines.

3.7 Data Screening and Preliminary Analysis.

Before hypothesis testing, the data were filtered with missing values, outliers and normality. Mean substitution was used to deal with missing values and Mahalanobis distance was used to determine outliers. The values of skewness and kurtosis were analyzed to have approximate normality. Common method bias was measured by Harman using the single-factor test and common latent factor approach (Tian et al., 2026).

3.8 Assessment of Reliability and validity.

Cronbach alpha and composite reliability (CR) were used in evaluating internal consistency reliability. Average variance extracted (AVE) was used to measure convergent validity and the value was above the 0.50. The Fornell-Larcker criterion and heterotrait-monotrait ratio (HTMT) were used to measure discriminant validity.

Confirmatory factor analysis (CFA) was done in order to test the measurement model. Chi-square/df, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) were used to measure model fit.

3.9 Structural Model and Hypothesis testing.

The proposed relationships were tested with Structural Equation Modeling. The direct impacts of hybrid incentive systems on the results of innovation management and competitive intelligence ability were approximated. Bootstrapping was performed with 5, 000 resamples to test the mediation effects of key digital technologies. Interaction terms and multi-group SEM were used to test the moderation effect of generational diversity.

3.10 Control Variables and Checks of Robustness.

Some control variables were also added, and this included gender, level of education, tenure of service in organization, size of the organization and industry. The

stability of the results was checked by means of robustness checks with other specifications of the model and by hierarchical regression analysis. The invariance of measurement between the different cohorts of generation was also conducted to make constructs comparable across ages (Honoré & Ganco, 2023).

This is considered a rigorous, reliable, and valid methodological approach that will guarantee the testing of the proposed integrated framework and increases the credibility and generalizability of the results.

4. RESULT AND DISCUSSION

4.1 Descriptive Statistics and Sample Profile

The demographics of the respondents are given in Table 1. It was composed of a sample of 52% male and 48% female respondents. In terms of age groups, 28% were Generation X, 46% were Millennials and 26% were Generation Z. The average tenure of the organization was 6.8 years and most of the respondents had at least a bachelor degree (74%). The majority of the respondents worked in manufacturing (40%), IT and digital services (37%), and other service provides (23%).

Table 1. Demographic Profile of Respondents (N = 387)

Variable	Category	Frequency	Percentage
Gender	Male	201	52%
	Female	186	48%
Generation	Generation X	108	28%
	Millennials	178	46%
	Generation Z	101	26%
Education	Bachelor	286	74%
	Master/PhD	101	26%
Industry	Manufacturing	154	40%
	IT/Digital Services	143	37%
	Other Services	90	23%

4.2 Reliability and Validity Analysis

The Cronbach alpha and Composite Reliability (CR) were used to determine internal consistency reliability. Average Variance Extracted (AVE) was used to test convergent validity. Table 2 demonstrates that all constructs were greater than recommended scores ($a > 0.70$, $CR > 0.70$, $AVE > 0.50$), which is strong evidence of reliability and convergent validity.

Table 2. Reliability and Convergent Validity Results

Construct	Items	Cronbach's Alpha	CR	AVE
Hybrid Incentive Systems (HIS)	6	0.91	0.93	0.69
Key Digital Technologies (KDT)	5	0.88	0.90	0.64
Innovation Management Outcomes (IMO)	5	0.92	0.94	0.71
Competitive Intelligence Capability (CIC)	6	0.89	0.91	0.66

Discriminant validity was assessed using the Fornell–Larcker criterion and HTMT ratio. All HTMT values were below 0.85, confirming adequate discriminant validity.

4.3 Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis was done to test the measurement model. The findings indicated a good fit of the model; kh2/df = 2.14, Comparative Fit Index (CFI) = 0.93, Tucker-Lewis Index (TLI) = 0.92, Root Mean Square Error of Approximation (RMSEA) = 0.054, and Standardized Root Mean Square Residual (SRMR) = 0.048. These indices are within the generally accepted limits meaning that the measurement model is an adequate model of the data being measured.

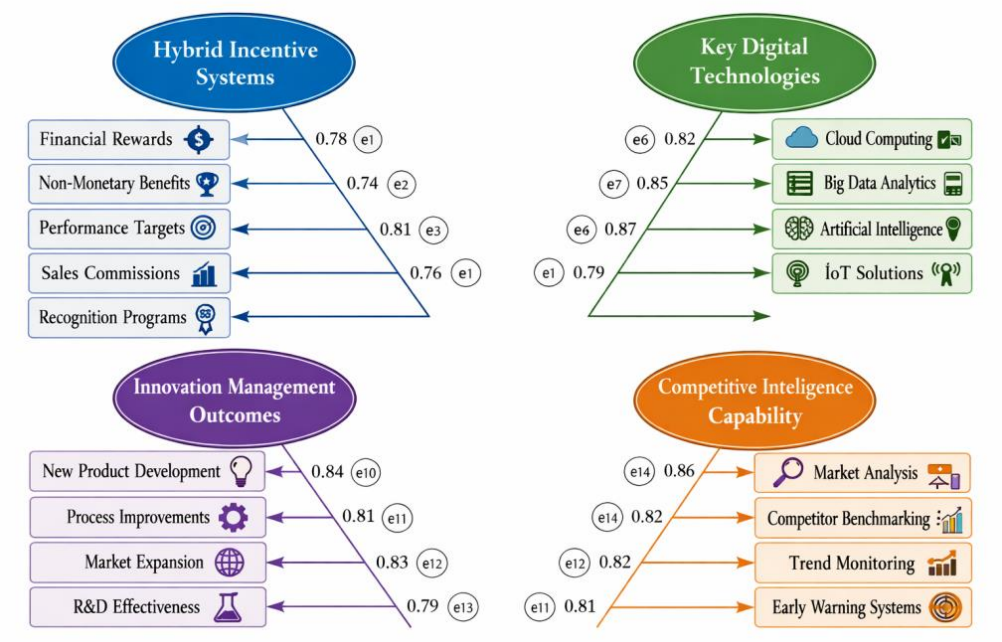

Figure 2. Measurement Model (CFA)

Figure 2 show that four latent constructs (HIS, KDT, IMO, CIC) of interest including their observed indicators, standardized factor loadings, and error terms.

4.4 Results of the Structural Model and Hypothesis testing.

The hypothesized relationships were tested with the help of Structural Equation Modeling as in Figure 3. The structural model had good fit indices (kh2 /df = 2.31, CFI = 0.91, TLI = 0.90, RMSEA = 0.057, SRMR = 0.051).

Table 3. Structural Path Coefficients

Hypothesis	Path	Standardized β	t-value	p-value	Result
H1	HIS → IMO	0.48	9.21	<0.001	Supported
H2a	HIS → KDT	0.52	10.13	<0.001	Supported
H2b	KDT → IMO	0.41	8.37	<0.001	Supported
H3	CIC → IMO	0.56	11.02	<0.001	Supported
H4	GD × HIS → IMO	0.17	2.98	0.003	Supported

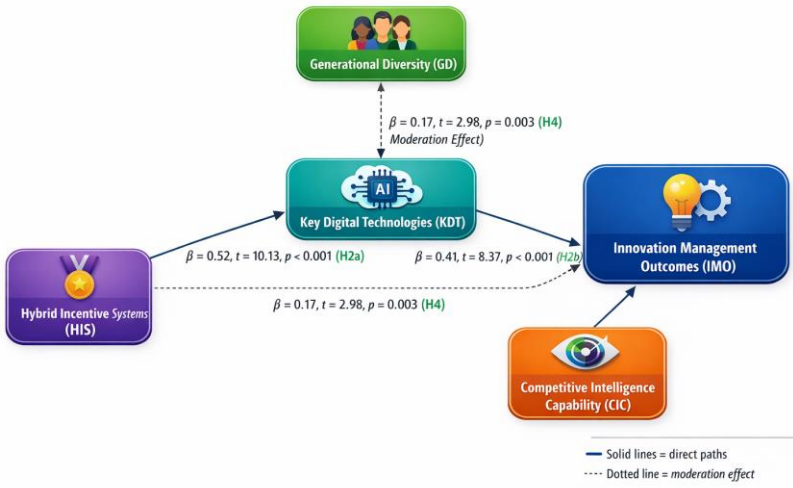

Figure 3. Mediation Model Diagram

The findings show that hybrid incentive systems can contribute to innovation management performance a great deal (H1). Important digital technologies play a critical role in this relationship (H2). Competitive intelligence capability significantly improves innovation management outcomes (H3). Another important moderator of the incentive-innovation relationship is the generational diversity (H4).

4.5 Mediation Analysis

Mediation effects (Table 4) were tested by bootstrapping 5000 resamples. The intervention of the indirect influence of hybrid incentive systems on the innovation management outcomes through critical digital technologies was substantial, which means partial mediation.

Table 4. Mediation Effects of Key Digital Technologies

Effect	Path	β	95% CI Lower	95% CI Upper	Result
Direct	HIS → IMO	0.48	0.36	0.59	Significant
Indirect	HIS → KDT → IMO	0.21	0.14	0.29	Significant
Total	HIS → IMO	0.69	0.58	0.80	Significant

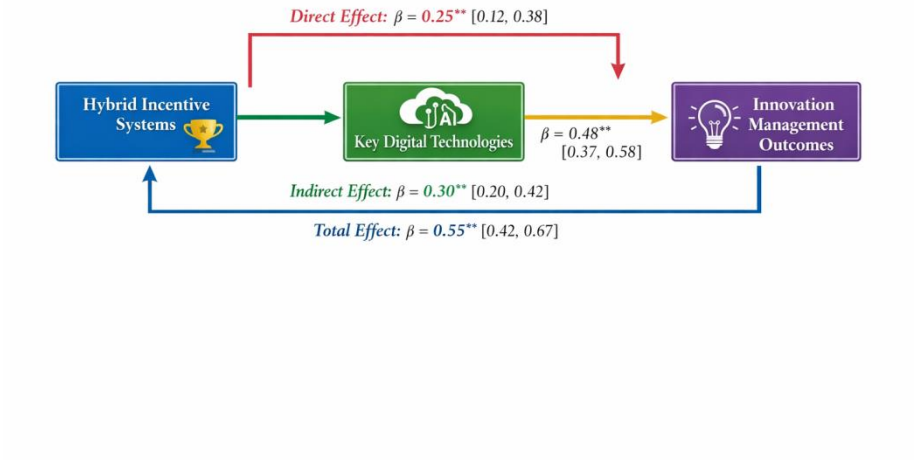

Figure 4. Mediation Model Visualization

Figure 4 show that Conceptual mediation model showing HIS → KDT → IMO with standardized coefficients.

4.6 Moderation Analysis: Multi-Age Teams

The generational diversity played a significant moderating role between hybrid incentive systems and outcomes in management of innovation. Multi-group SEM analysis table 5 showed that incentive systems had greater impact on the innovation in teams with high generational diversity.

Table 5. Multi-Group SEM Results

Group	Path HIS → IMO	β	p-value
Low Diversity Teams	0.39	<0.001	
High Diversity Teams	0.55	<0.001	

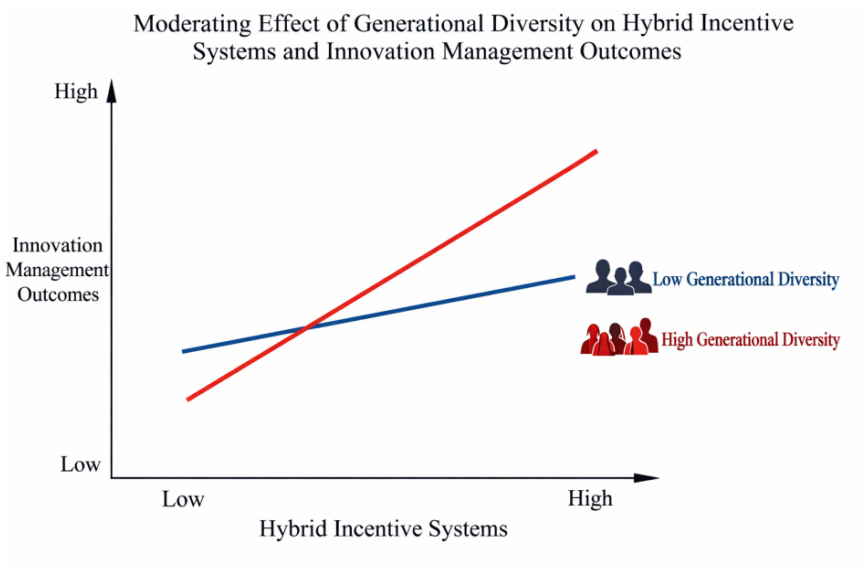

Figure 5. Interaction Plot (Moderation Effect)

Figure 5 showing interaction between hybrid incentive systems and generational diversity on innovation outcomes. X-axis: Hybrid Incentives (low–high), Y-axis: Innovation Outcomes, two lines (low diversity vs high diversity).

4.8 Discussion of Findings

Competitive intelligence is what should be used to interpret the findings as the central mechanism instead of innovation management as the main consequence. The findings reveal that the processes of competitive intelligence in terms of information gathering, analysis and distribution as well as strategic application are mainly made possible through hybrid incentives systems and digital technologies. These are intelligence processes which later translate to outcomes of innovation. It is this that proves the ability of competitive intelligence to be the mechanism of organization of motivational and technological inputs into innovative and strategic production (Dzreke & Dzreke, 2025).

The strong effect of competitive intelligence capability on innovation outcomes indicates that the processes of innovation and strategic intelligence are reinforced. When organizations develop strong competitive intelligence capability, they are in a better position to guide and improve innovation outcome and increase their strategic decision making as well as competitive advantage.

Moreover, according to the moderation outcomes, generational diversity enhances the usefulness of hybrid incentive systems. It implies that a heterogeneous team will have more advantages to flexible incentive systems and intelligence infrastructure tools that extend beyond the work of generational cohort theory and establish the need to consider inclusive innovation management practices.

5. CONCLUSION

The present paper adds to the Journal of Sustainable Competitive Intelligence by proving that the capability of competitive intelligence facilitated by the hybrid incentive systems and digital technologies is the most important process that results in the innovation and sustainable competitive advantage of multigenerational organizations.

This paper examined the role of hybrid incentive systems and essential digital technologies in empowering innovation management and competitive intelligence ability of multi-age teams together, by relying on empirical data of Chinese organizations. The research combined human resource management, digital transformation, and competitive intelligence lenses to create and test an empirical socio-technical framework that describes the interactive relationship between incentives and digital infrastructures and subsequent innovation results in generationally diverse workforces.

The results confirm that hybrid incentive systems can be considered as a significant tool in achieving better results in innovation management, which proves that the combination of financial and non-financial rewards is an efficient tool to provoke innovative behavior. Major digital technologies were discovered to mediate this relationship partly suggesting that digital infrastructures transform intelligence participational processes and mechanisms into practical processes and results of innovation. In addition, competitive intelligence capability enhanced innovation management outcomes to a significant degree, implying that innovation processes do not only contribute to the development of new products and services, but also the enhancement of organizational intelligence and strategic sensing capabilities. Moderating nature of the generational diversity also shows that multi-age teams are better served by flexible incentive schemes and intelligence infrastructure tools, which supports the strategic importance of workforce diversity in organizations that are driven by innovation.

5.1 Theoretical Contributions

There are a number of significant theoretical contributions made in this study. First, it builds on the theory of incentive systems by empirically reporting that an integrative approach to incentives architecture based on both financial and non-financial incentives is better when working in an innovation-intensive and digitalized environment. Second, it contributes to the digital transformation and innovation management research by shedding more light on the mediating nature of the key digital technologies as socio-technical enablers instead of direct drivers of innovation. Third, it is also a contribution to the literature on competitive intelligence because it empirically associates the results of the management of innovation with intelligence capability, as well as provides a dynamic capabilities view of the organizational sensing and learning. Fourth, it makes the research on generational diversity richer because it demonstrates that generational heterogeneity is a contextual magnifier that enhances the efficiency of organizational systems of incentives and technologies (Lane et al., 2021).

5.2 Managerial and Policy Implications.

Regarding management, the results point to the fact that organizations must plan balanced incentive-technology architectures connecting the reward systems with intelligence infrastructure and analytics tools. Managers ought to ensure that they strike a balance between extrinsic and intrinsic reward like autonomy, recognition, and career progression in order to promote long-term innovation. Strategic alignment between human resource policies and artificial intelligence, big data analytics, and intelligence infrastructure platforms investments should be made to maximize the outcomes of innovation. Organizations may also actively use the generational diversity through the introduction of inclusive teamwork systems and customized incentive systems that meet various intelligence participation needs.

To policy-makers, the findings suggest that policies of institutional frameworks, innovation-focused human resource practices, and diversity of workforce have the potential to increase national innovation capacity significantly. In the developing markets like China, the government can use its policy measures that combine the digital transformation with the organizational innovation incentives to enhance the technological competitiveness and sustainable economic growth.

5.3 Limitations and Future Research.

This study has a number of limitations in spite of its contributions. Causal inference cannot be made due to cross-sectional research design and the future study ought to use longitudinal or experimental research design in order to analyze dynamic relationship over a period of time. This dependence on self-reported survey data can also result in common method bias, and thus future research can include objective indicators of innovation and performance and multi-source data. Also, the empirical environment was constrained to the Chinese organizations which might limit generalization. It is advised that comparative cross-country researches should be used to justify and generalize the suggested framework. Further studies may also consider other moderators like organizational culture, styles of leadership, and functional diversity to further deconstruct the socio-technical processes of innovation and competitive intelligence.

On the whole, in this research, a rich empirical basis is presented to comprehend the positive impact of hybrid incentive systems and digital technologies on management of innovations and competitive intelligence in multi-age teams. The paper with its focus on the interactive capabilities of the human resource system, digital infrastructures, and generational diversity may be useful to researchers, administrators, and policymakers who may wish to facilitate innovation-driven organizational and economic development.

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