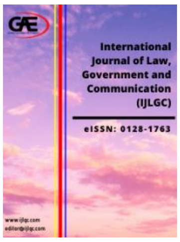
International Journal of Law, Government and Communication IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005



INTERNATIONAL JOURNAL OF LAW, GOVERNMENT AND COMMUNICATION (IJLGC)
www.ijlgc.com

FROM SECURITY TO SUSTAINABILITY: HUMAN CAPITAL DEVELOPMENT AND THE ECONOMIC FUTURE OF MALAYSIA'S DEFENCE INDUSTRY

Othman Asmanur[1], Nur Surayya Mohd Saudi[2*], Rogis Baker[3], Mohd Haizam Mohd Saudi[4]

[1] Faculty of Defence Studies and Management, National Defence University of Malaysia
Email: asmanursaibah@gmail.com
[2] Faculty of Defence Studies and Management, National Defence University of Malaysia
Email: nursurayya@upnm.edu.my
[3] Faculty of Defence Studies and Management, National Defence University of Malaysia
Email: rogis@upnm.edu.my
[4] Graduate Business School, Universiti Keusahawanan Koperasi Malaysia
Email: haizam@ukkm.edu.my
[*] Corresponding Author

Article Info:

Article history:
Received date: 30.09.2025
Revised date: 18.10.2025
Accepted date: 06.11.2025
Published date: 01.12.2025

To cite this document:

Asmanur, O., Saudi, N. S. M., Baker, R., & Saudi, M. H. M. (2025). From Security to Sustainability: Human Capital Development and the Economic Future of Malaysia's Defence Industry. *International Journal of Law, Government and Communication, 10* (42), 56-72.

DOI: 10.35631/IJLGC.1042005

Abstract:

This study investigates the role of Human Capital Development (HCD) in advancing Malaysia’s defence industry and its contribution to economic growth. Using time series data from 1991 to 2023, the analysis found that employment, education expenditure, and exports significantly Granger-cause GDP, underscoring the importance of skilled labour and strategic investments in education. Conversely, military expenditure and arms imports show no short-run causal impact, indicating the current defence sector's limited economic integration and technological depth. The findings reveal a critical gap between national HCD efforts and defence sector needs, hindering innovation and self-reliance. To bridge this gap, the study recommends strengthening defence-focused training, increasing investment in dual-use R&D, enhancing defence export competitiveness, and reallocating spending toward capability development. A coordinated, defence aligned with HCD strategy is essential to position the sector as both a security asset and a driver of inclusive, long-term economic growth.

Keywords:

Defence Self-Reliance, Economic Impact, Human Capital Development, Malaysia Defence Industry, Sustainable Economic Growth

International Journal of Law, Government and Communication
IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005

Introduction

The defence industry is increasingly recognised as a strategic pillar of national development due to its role in safeguarding sovereignty, stimulating technological innovation, and enhancing long-term economic resilience. For emerging economies like Malaysia, the development of an indigenous defence sector is not solely a matter of national security it also serves as a driver of industrial growth, innovation, and economic independence. A robust and strategically aligned defence industry reduces reliance on foreign suppliers, builds local capabilities, and generates wider socio-economic benefits through spillovers into manufacturing, research and development (R&D), and employment creation.

Within this framework, Human Capital Development (HCD) is a critical enabler. HCD encompasses investments in education, vocational and technical training, and institutional capacity-building. These investments enhance workforce productivity and improve the competitiveness of the defence sector. International examples such as South Korea and Turkey illustrate how aligning HCD with defence industrial strategies can foster technological self-reliance, strengthen export competitiveness, and contribute to economic growth. However, Malaysia continues to face key challenges, including fragmented HCD initiatives, insufficient funding for skill development, and a misalignment between academic output and defence industry requirements.

The defence industry refers to the sector of the economy responsible for producing and supplying military goods, technologies, and services that support national defence and security. It includes both public and private entities involved in the development, manufacturing, maintenance, and logistics of military equipment such as weapons, ammunition, vehicles, aircraft, naval ships, and advanced technologies like cybersecurity systems and surveillance tools. The industry also encompasses research and development (R&D), support services, and dual-use technologies with civilian and military applications. As a strategic sector, the defence industry plays a vital role in safeguarding sovereignty, enhancing military readiness, fostering technological innovation, creating employment, and contributing to economic growth.

Malaysia's defence industry comprises key players such as Deftech (armored vehicles), SME Ordnance (ammunition and small arms), Boustead Heavy Industries Corporation (naval shipbuilding), AIROD and CTRM (aerospace and UAV components), Zetro Services (avionics and radar systems), Sapura Secured Technologies (secure communications and cyber defence), and STRIDE (defence R&D). These entities, spanning both government-own companies and private firms, contribute to Malaysia's economy by driving industrial growth, supporting high-skilled employment, enhancing local manufacturing capabilities, and reducing reliance on foreign defence imports. Through strategic investments, local content development, and technology transfer from international collaborations, the defence industry plays a vital role in strengthening national security while simultaneously advancing technological innovation and creating economic spillover effects in engineering, electronics, logistics, and education sectors.

This study empirically evaluates the economic impact of HCD on Malaysia's defence sector by analysing selected HCD-related indicators which are assessed in terms of their relationship to national productivity, sustainable economic growth, and defence self-reliance. This study employed an econometrics analysis using annual time series data from 1991 to 2023. The framework below summarises how each variable aligns with key economic outcomes relevant to future Malaysia's defence industry:

International Journal of Law, Government and Communication
IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005

Table 1: Economics Indicator and The Significance to Malaysia's Defence Industry

Economic Area	Indicator	HCD Relevance	Relation to Economic Area	Significance to Malaysia's Defence Industry
1. National Productivity	- Gross Domestic Product (GDP) - Employment in Industry (EMPI)	- HCD improves labour quality, raising GDP and industrial output - EMPI shows alignment between skills and job market needs	- GDP reflects overall national productivity - EMPI indicates strength of industrial workforce	- Higher productivity supports defence manufacturing, MRO, and logistics - Enables domestic capability growth and reduces foreign dependency
2. Sustainable Economic Growth	- GDP - Imports of Goods & Services (IMGS) - Exports of Goods & Services (EXGS) -Adjusted Savings: Education Expenditure (EDUEXP)	- Skilled human capital boosts export competitiveness - Reduces import dependency through local production and innovation - EDUEXP reflects national investment in education and future HCD	- Balanced trade ensures resilience and sustainability - GDP and trade values indicate economic direction -Balanced trade and education investment ensure long-term growth and resilience	- HCD supports transition to export-oriented defence sector - Sustained growth funds innovation, R&D, and strategic defence investments - Sustained economic growth supports defence R&D and innovation-driven industrial development
3. Defence Self-Reliance	- Arms Imports (AI) - Military Expenditure (ME)	- Investment in defence-specific training, engineering, and planning reduces reliance on imported technology - HCD enables local R&D and procurement	- AI highlights tech dependence; lower AI = higher self-reliance - ME used more efficiently when tied to HCD	- Reducing arms imports strengthens autonomy - Skilled workforce ensures local design, production, and maintenance of defence systems

Source: Author's Framework

The defence industry is widely seen as a strategic sector because of its important role in protecting national sovereignty, building self-reliance in key technologies, and supporting both national security and economic strength. A strategic sector is usually an industry that is important to a country's core interests, where the government takes an active role in its development and protection due to its impact on security, industry, and long-term economic

Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005

stability (OECD, 2021; Lall, 2004). In this context, Malaysia's defence industry is not just about military strength it also plays a key role in supporting goals such as technology advancement, industrial growth, and economic independence.

Malaysia's defence sector is not only important for national security but also has the potential to support social and economic progress. By reducing dependence on imported defence equipment and developing local capabilities, the country aims to build greater independence in a rapidly changing global environment (Ministry of Defence Malaysia, 2020). Apart from defending the nation, the defence sector could also help boost economic growth through technology transfer, job creation, and the development of local industries. However, despite its importance, the economic value of the sector is still not well studied or fully used, especially in terms of how it supports sustainable national development (Yusof, 2021; Baharom et al., 2021).

Around the world, many countries are now seeing their defence industries as drivers of innovation and economic growth. Countries like South Korea and Turkey have successfully built strong defence industries by investing in talent development, research, and public-private partnerships. Their experiences show that developing skilled workers is key to creating local technology, helping small and medium-sized companies, and building long-term industry strength (Lee et al., 2021). In Malaysia, however, there are still several challenges, such as uncoordinated education and training efforts, low investment in research, limited cooperation between universities and industry, and a mismatch between graduates' skills and what the defence sector needs (HRMARS, 2023; Baharom & Yusof, 2021).

In this situation, Human Capital Development (HCD) is a key factor in turning the defence sector into a valuable part of the economy. HCD includes education, training, skills upgrading, knowledge sharing, and strengthening institutions. When properly aligned to national development plans, HCD can help fix skill gaps, increase worker productivity, and promote innovation through research and new technology (Becker, 1964; Romer, 1990). It can also support knowledge-sharing and new business creation, especially in high-tech areas that benefit both military and civilian sectors.

The Malaysian Defence White Paper (2020) provides a clear vision to strengthen local capabilities and build a more self-sufficient defence industry. However, HCD efforts are still scattered among different agencies, and not yet fully integrated with long-term defence plans. Studies have shown that building a strong defence industry requires not just financial investment, but also clear human capital strategies that are designed to meet the specific needs of the sector (Kamaruddin et al., 2021). This paper explores how investing in Human Capital Development can improve the economic role of Malaysia's defence industry.

Literature Review

Underlying Theory

The theoretical foundation for the relationship Human Capital Development (HCD) with economic performance stems from classical and endogenous growth models. Pioneers such as Schultz (1961) and Becker (1964) emphasized that investments in education and training lead to improved labour productivity, which in turn drives economic growth. Romer's (1990) endogenous growth theory further expanded this understanding by highlighting how human

International Journal of Law, Government and Communication IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005
capital contributes to knowledge accumulation and innovation key engines of long-term economic development.

National Productivity, Sustainable Economic Growth and Defence Self-Reliance Nexus
In the context of the defence industry, HCD assumes heightened importance. National productivity, often proxied by GDP and employment in industry, depends significantly on the availability of a skilled workforce. Barro (2001) and Psacharopoulos & Patrinos (2018) argue that countries with well-aligned education systems and labour market structures achieve higher industrial efficiency. For Malaysia, this implies the need to enhance technical and vocational education and training (TVET) to support defence manufacturing, maintenance, repair and overhaul (MRO), and advanced systems integration.

Sustainable economic growth is also have the relationship to HCD through its effects on trade, innovation, and structural transformation. A skilled workforce boosts export capacity and reduces dependency on imports, thereby improving trade balances. Hanushek & Woessmann (2012) show that the quality of education has a direct impact on national economic outcomes, particularly in innovation-intensive sectors. Malaysia's adjusted savings in education expenditure (EDUEXP), a proxy for public investment in future productivity, reflects its strategic prioritisation of HCD.

Malaysia's Defence Industry Self-Reliance
In the Malaysian context, the Defence White Paper (Ministry of Defence Malaysia, 2020) underscores the strategic imperative of enhancing national self-reliance by developing a robust indigenous defence industry. The document outlines key policy priorities, including the strengthening of local defence capabilities, the promotion of technological advancement, and the enhancement of human resource readiness. However, it also acknowledges several persistent challenges, particularly in the areas of research and development (R&D), skilled workforce availability, and inter-agency collaboration. These gaps are further supported by empirical studies; for example, Yusof and Zainuddin (2022) highlight that Malaysia's defence human capital pipeline is fragmented and misaligned with the actual demands of the industry.
Crucial to the success of Malaysia's National Defence Industry (NDI) is the development of a dedicated, industry-centric workforce, supported by an education system tailored to meet the sector's needs (Rusland & Saudi, 2023). Defence self-reliance key goal outlined in Malaysia's Defence White Paper (2020) relies on the ability to develop, maintain, and innovate defence technologies locally. Countries like Turkey and Brazil have demonstrated that targeted HCD strategies can lead to significant advancements in indigenous defence capabilities. The reduction of arms imports (AI) and the efficient use of military expenditure (ME) are often the result of a mature defence ecosystem supported by skilled engineers, technicians, and policy planners. Despite these global lessons, research specifically examining the HCD-defence-economic growth nexus within Malaysia remains limited. Most existing studies either focus narrowly on security or do not quantitatively analyse the economic contributions of the defence sector.

Economics outcomes from National Defence Industry
From a theoretical perspective, the relevance of HCD to economic outcomes in the defence sector is well-grounded in Human Capital Theory (Becker, 1964). The theory posits that investments in education, skills, and training enhance individual productivity, which in turn contributes to macroeconomic growth. Endogenous Growth Theory (Romer, 1990)

International Journal of Law, Government and Communication
IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005

complements this view by emphasizing the centrality of innovation and knowledge spillovers as internal drivers of sustained economic progress. These theoretical frameworks collectively support the hypothesis that enhancing human capital within the defence sector through targeted education, technical training, and R&D collaboration can yield significant economic dividends. Nonetheless, scholarly attention to the intersection of HCD and the defence industry in Malaysia remains limited. While regional literature has examined broader themes of workforce development and industrial innovation (Rahman et al., 2020; Ahmad & Kassim, 2019), few studies have specifically interrogated how strategic human capital investments influence the performance and sustainability of indigenous defence production. This research gap is notable given the increasing complexity of modern defence systems, which demand a workforce that is not only technically proficient but also capable of cross-disciplinary collaboration and innovation.

International experiences offer valuable comparative insights. For instance, Kim (2020) discusses South Korea's integration of HCD into defence planning as a key factor behind its successful transition from arms importer to exporter. Similarly, Kaya (2022) illustrates how Turkey's defence industry benefitted from targeted policies that related with academic institutions, vocational training, and industry needs. These examples suggest that an intentional, ecosystem-based approach to HCD can catalyse the transformation of a nascent defence sector into an engine of economic growth. In conclusion, the literature indicates that the integration of HCD into defence industrial strategies is both theoretically justified and empirically supported in various international contexts. However, Malaysia's indigenous defence industry continues to face structural constraints that limit the full realisation of its economic potential. A more coherent and data-informed approach to HCD could thus serve as a foundational element in reorienting the sector towards greater innovation, resilience, and economic contribution.

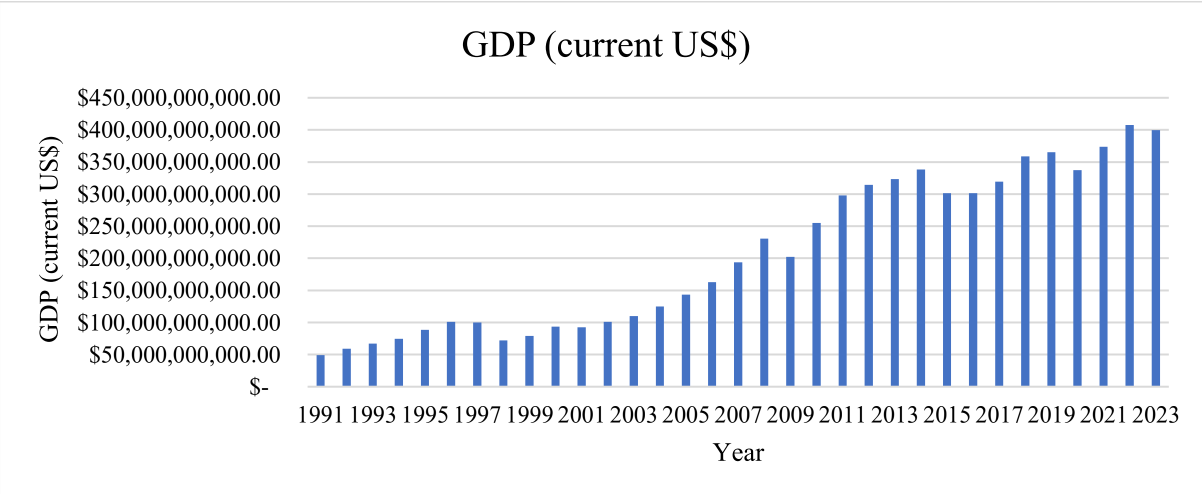


Figure 1: Malaysia GDP from 1991 to 2023

Source: World Bank Data (2024)

Figure 1 depicted Malaysia’s GDP trend from 1991 to 2023 shows strong long-term growth, rising from approximately USD 49 billion in 1991 to nearly USD 400 billion in 2023. The country experienced rapid economic expansion in the early 1990s, followed by a sharp contraction during the 1997–1998 Asian Financial Crisis. Recovery resumed into the 2000s until the 2009 Global Financial Crisis caused a temporary dip. A significant rebound occurred

Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005

in the following years, with GDP peaking in 2014, but growth slowed slightly in 2015–2016. After steady improvement up to 2019, the economy contracted again in 2020 due to the COVID-19 pandemic. However, a strong recovery was seen in 2021 and 2022, reaching over USD 407 billion, before a slight decline in 2023, possibly due to global economic uncertainties. Overall, the chart reflects Malaysia's economic resilience, cyclical vulnerabilities, and capacity for post-crisis recovery. Based on this historical trend, Malaysia's GDP is expected to continue its upward trajectory, supported by structural reforms, digital and green economy transitions, regional trade integration, and infrastructure investments. Nonetheless, future growth may face headwinds from external risks such as geopolitical instability, global inflationary pressures, and fluctuations in commodity prices, which require prudent fiscal and monetary policies to sustain long-term economic momentum.

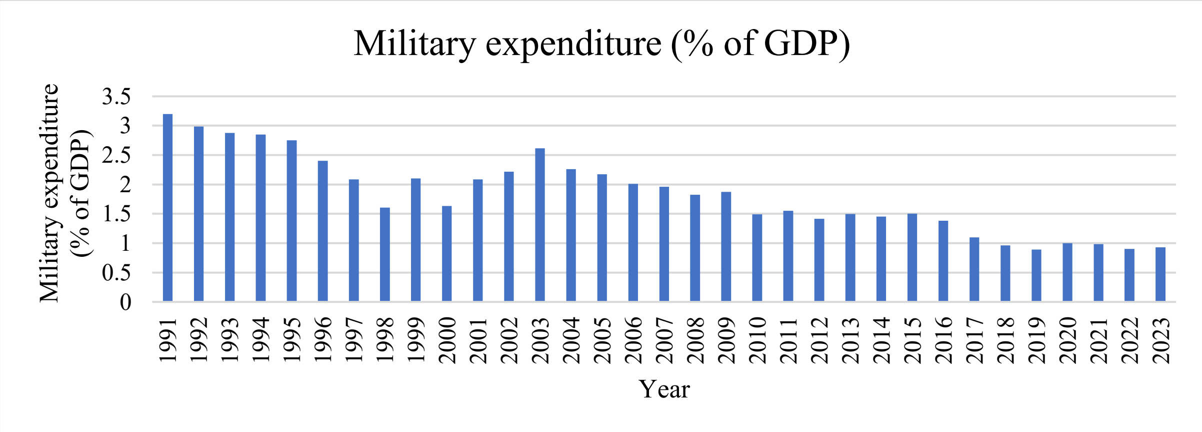


Figure 1: Malaysia GDP from 1991 to 2023

Source: World Bank Data (2024)

Figure 2 show the declining trend in Malaysia's military expenditure as a percentage of GDP from 1991 to 2022 presents both challenges and opportunities for the future growth of the national defence industry. Military spending fell steadily from over 3.1% of GDP in 1991 to below 1% in 2018, stabilising around 0.9% by 2022. This contraction, influenced by fiscal austerity during economic crises defence such as the 1997 Asian Financial Crisis, the 2008 Global Financial Crisis, and the COVID-19 pandemic defence reflects Malaysia's tendency to deprioritise defence in favour of short-term economic and social spending. While this approach may support immediate economic resilience, it risks constraining the growth of a robust and self-reliant defence industrial base. Without sustained investment, Malaysia's defence sector faces limitations in technological innovation, domestic manufacturing capacity, and supply chain development defence key pillars for long-term economic resilience and strategic autonomy. However, the downward spending trend also presents a strategic opportunity: to pivot from a procurement-heavy model to one that emphasises value creation through local industry participation, public–private partnerships, and dual-use technology innovation. With proper policy alignment defence such as dedicated industrial incentives, research and development funding, and integration with national economic planning defence the Malaysian defence industry could still emerge as a catalyst for high-value job creation, technology transfer, and national competitiveness, even within a constrained fiscal environment. Therefore, while declining military expenditure poses immediate constraints, it could also spur a strategic shift toward an innovation-led and economically integrated defence ecosystem.

International Journal of Law, Government and Communication
IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005

Data and Methodology

Data used in this study are annual basis which cover time series data from 1991 to 2023. The variables are Gross Domestic Product (GDP) measured in current US dollars, Employment in Industry (EMPI) expressed as a percentage of total employment, Imports of Goods and Services (IMGS) in current US dollars, Exports Of Goods And Services (EXGS) in current US dollars, Adjusted Savings For Education Expenditure (EDUEXP) in current US dollars, Arms Imports (AI) based on indicator values, and Military Expenditure (ME) in current US dollars. Data were collected from World Bank Development Indicators (World Bank, 2014). GDP is at constant US $ prices. All variables are transformed into the natural logarithmic form in order to capture growth effects (Katircioglu, 2009).

Table 2: Classification of Variables

Variable	Type
Gross Domestic Product (GDP) (USD)	Dependent
Employment in industry (EMPI) (%)	Independent
Military expenditure (ME) (% of GDP)	Independent
Arms imports (AI) (%)	Independent
Imports (IMGS) (USD)	Independent
Exports (EXGS) (USD)	Independent
Education Expenditure (EDUEXP) (USD)	Independent

Source: World Bank and SIPRI

The relationship between the defence industry and economic growth can be understood through various economic indicators. Gross Domestic Product (GDP) serves as the dependent variable that reflects overall economic performance, while independent variables such as employment in industry, military expenditure, arms imports, imports, and exports influence GDP in different ways. Higher employment in the industrial sector, particularly if it includes defence-related manufacturing, is generally associated with increased productivity and output, thereby contributing positively to economic growth. Central to this is human capital development, as a skilled and adaptable workforce is essential for sustaining growth in both industrial and defence-related sectors. Investment in technical education, upskilling programs, and research-oriented human resources enhances the capacity of domestic firms to absorb advanced technologies, innovate, and meet the evolving demands of the global defence economy. Military expenditure, measured as a percentage of GDP, has a more nuanced effect; while it can stimulate economic activity through government demand and innovation in defence technologies, excessive or inefficient spending may divert resources from more productive sectors. Arms imports, on the other hand, often result in capital outflow and limited domestic benefit unless accompanied by technology transfer or offset agreements that contribute to local capability development. General imports may have a short-term negative impact on GDP due to leakage of resources abroad, but they can support long-term growth if they include strategic inputs like defence components or capital goods. Conversely, exports especially those involving defence equipment or dual use technologies can significantly enhance GDP by generating foreign exchange, stimulating domestic production, and encouraging industrial competitiveness. Therefore, the economic impact of the defence industry is shaped not only by the volume of defence-related activities but also by the strategic direction, policy efficiency, human capital readiness, and integration of these sectors within the broader economy.

International Journal of Law, Government and Communication
IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005

Methodology
The Augmented Dickey–Fuller (ADF) performed to determine the order of integration of the variables (Dickey and Fuller, 1981 and the Johansen test is employed to estimate the possible long-run equilibrium relationship between these variables (Johansen and Juselius, 1990). At last, Granger causality test is used to analyse the direction of the causal relationship between the variables (Granger, 1988).

Empirical model
This study suggests that Malaysia's Gross Domestic Product (GDP) is influenced by several key variables related to human capital. Thus, the fundamental equation for this study can be shown as follows:

$$lnGDP = f (lnEMPI, lnIMGS, lnEXGS, lnEDUEXP, lnAI, lnME) \quad (1)$$

Where InGDP is Gross Domestic Product per capita (current US$), lnEMPI is Employment in Industry, lnIMGS is Import Goods and services, lnEXGS is Export Good & Services, lnEDUEXP is Education Expenditure, lnAI is Arms Imports and lnME is Military expenditure.

Table 3: Source of Data

Variables	Details	Source
Gross domestic product (GDP) (current US$)	Gross domestic product is the total income earned through the production of goods and services in an economic territory during an accounting period.	World Bank
Employment in industry (EMPI) (% of total employment)	Employment is defined as persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. The industry sector consists of mining and quarrying, manufacturing, construction, and public utilities.	World Bank
Imports of goods and services (current US$) (IMGS)	Imports of goods includes change in the economic ownership of goods from non-residents to residents of the compiling economy, irrespective of physical movement of goods across national borders.	World Bank
Exports of goods and services (EXGS) (current US$)	Exports of goods includes changes in the economic ownership of goods from residents of the compiling economy to non-residents, irrespective of physical movement of goods across national borders.	World Bank
Adjusted savings: education expenditure (EDUEXP) (current US$)	Education expenditure refers to the current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment. This indicator is expressed in current prices, meaning no adjustment has been made to account for price changes over time. This indicator is expressed in United States dollars.	World Bank
Arms imports (AI) indicator values	Arms transfers (imports) cover the volume of transfers of major arms through sales and gifts, and those made	Stockholm Internation

International Journal of Law, Government and Communication IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005

	through manufacturing licenses. Data cover major conventional weapons such as aircraft, armoured vehicles, artillery, radar systems, missiles, and ships.	al Peace Research Institute (SIPRI)
Military Expenditure (ME)	Military expenditures data from SIPRI are derived from the NATO definition, which includes all current and capital expenditures on the armed forces, including peacekeeping forces; defence ministries and other government agencies engaged in defence projects; paramilitary forces, if these are judged to be trained and equipped for military operations; and military space activities.	World Bank

All variables are transformed into their natural logarithmic forms to ensure linearity and to interpret coefficients as elasticities. The log-linear form also helps capture proportional growth effects between variables such as GDP, military expenditure, and other economic indicators. A simplified version of the estimation equation is as follows:

$$In\ GDP = \beta_0 + \beta_1 \ln EMPI + \beta_2 \ln IMGS + \beta_3 \ln EXGS + \beta_4 \ln EDUEXP + \beta_5 \ln EMAIPI + \beta_6 \ln ME + \varepsilon_t \qquad (2)$$

lnGDP refers to the natural logarithm of Gross Domestic Product, while *lnEMPI*, *lnIMGS*, *lnEXGS*, *lnEDUEXP*, *lnAI*, and *lnME* are the natural logs of employment in industry, imports of goods and services, exports of goods and services, education expenditure, arms imports, and military expenditure respectively. The coefficient β_0 represents the intercept of the equation, and β_1 to β_6 denote the elasticities of the independent variables, showing the percentage change in GDP resulting from a one percent change in each explanatory variable. The term ε_t is the error term at time *t*, capturing unobserved factors that may influence GDP.

Unit Root Tests

Unit root tests are used to examine whether the time series variables are stationary or non-stationary. This study employs the Augmented Dickey-Fuller (ADF) test, as developed by Dickey and Fuller (1981), to determine the order of integration of the variables under investigation. The ADF test is widely used in econometric studies due to its ability to handle more complex error structures than the basic Dickey-Fuller test by including lagged difference terms. Enders (1995) suggests using models with both trend and intercept as a starting point for such tests.Lag length is 2. The ADF equation is given as:

$$\Delta y_t = \alpha_0 + \lambda_{yt-1} + \alpha_2 t + \sum_{i=2}^{p} \beta_j \Delta y_{t-i-1} + \varepsilon_t \qquad (3)$$

Where y is the dependent variable, α is the drift, t is trend, ε is a noise and p represents the lag level. To ensure that the errors are white noise, the number of lags “p” of the dependent variable be determined by using the Akaike Information Criteria (AIC) or some other alternative criteria (Katircioglu et al., 2007). ADF tests apply t-test for λ. Null hypothesis of these tests is the series

International Journal of
Law, Government and Communication
EISSN : 0128-1763
IJLGC
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005
is non-stationary. If the series is stationary at level, the series is called integrated of order zero, I(0). When the series is stationary at first differences, it is called integrated of order one, I(1).

Cointegration Tests
In this part, the possible long-run equilibrium relationship between the variables is investigated. The present research is based on Johansen methodology that is used to test cointegration among variables those have the same order of integration. Minimum one co-integrating vector is required in order to have co-integration between variables. Johansen test takes its initial point in the vector auto regression (VAR) of order p expressed as;

$$y_t = \mu + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_P y_{t-p} + \varepsilon_t \quad (4)$$

Where yt, y_{t-1}, …, y_{t-p} are vectors of level and lagged values of P variables respectively. All assumed to be I(1) in the model; A_1, …, A_p are coefficient matrices with (PXP) dimensions; μ is a vector of intercept, ε_t is a vector of random errors. Johansen (1988) and Johansen and Juselius (1990) developed the trace statistic to test the number of cointegrating relationships. The trace statistic (λtrace) could be estimated by the formula below;

$$\lambda_{trace} = -T\Sigma \, ln(1 - \lambda_i), \quad i = r + 1, \ldots, n - 1 \quad (5)$$

Where λ_i are the estimated eigenvalues from the Johansen test, T is the sample size, r is the number of cointegrating vectors under the null hypothesis.
The null hypotheses are given as follows;

H0: r = 0 H1: r ≥ 1
H0: r ≤ 1 H1: r ≥ 2
H0: r ≤ 2 H1: r ≥ 3

Where r represents the number of cointegrating vectors. The null hypothesis (H_0) is rejected if the trace statistic exceeds the critical value, indicating the presence of at least one long-run relationship among the variables.

Granger Causality Tests
This test is performed to identify the direction of the causal relationship between variables. The casual relationships can be either unidirectional or bi-directional. This test estimates the following equations assuming there is no correlation between u1t andu2t.

$$InGDP_t = \sum_{i=1}^{n} \alpha_i InX_{t-i} + \sum_{j=1}^{n} \beta_j InGDP_{t-j} + u_t \quad (6)$$

Where InX_t represents each independent variable in natural logarithmic form (lnEMPI, lnIMGS, lnEXGS, lnEDUEXP, lnAI, lnME), α_i, $\beta_j, \lambda_i, \delta_j$ are coefficients to be estimated, u_t is the error term. Each variable InX_t is individually tested against $InGDP_t$ to determine whether past values of X Granger-cause GDP. If the coefficients α_i are jointly statistically significant, we reject the null hypothesis that X does not Granger-cause GDP.The null hypothesis is that there is no Granger causality from one variable to another. If rejected, it suggests the existence of a predictive relationship.Lag length applied is 2.

International Journal of Law, Government and Communication IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005

Empirical Results

Unit Root Test

According to ADF series are stationary at the first differences which means series are integrated of order one, (1). The following table indicates the results of ADF tests:

Table 4: ADF unit roots

Variable	Level tT (ADF)	Level tm (ADF)	Level t (ADF)	1st Diff tT (ADF)	1st Diff tm (ADF)	1st Diff t (ADF)
lnGDP	-2.92	-0.15	-4.16	-5.53*	-5.67	-3.40*
lnEMPI	-5.67	-0.66	-5.78	-4.33*	-5.89	-6.87*
lnAI	-2.78	-0.65	-0.59	-5.13*	-4.95	-5.45*
lnME	-1.87	-0.89	-0.78	-6.77*	-7.90	-4.55*
lnIMGS	-4.32	-0.77	-0.99	-5.88*	-6.77	-5.77*
lnEXGS	-3.21	0.44	-0.44	-8.99*	-5.78	-3.77*

Notes: 'tT' test with trend and intercept, 'tm' test with intercept only, and 't' is without trend or intercept. Asterisks * denote significance at the 1% level. Lag length set at zero (0) using AIC.

Cointegration Analysis

Since all series are I(1), Johansen's cointegration test was employed to investigate whether a long-run equilibrium relationship exists among the variables in the model. The trace test confirms at least one cointegrating vector at the 5% significance level, indicating the presence of a long-run relationship between GDP and its explanatory variables. Results of the test are shown in the following table.

Table 5: Johansen Test for Cointegration

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics	5 Percent Critical Value	1 Percent Critical Value
None*	0.768674	31.12422	15.41	20.04
At most 1	0.552101	17.64210	14.07	18.63

Note: ** shows the rejection of the null hypothesis at 5% level of alpha

Based on Johansen Cointegration test, a long-run relationship exists between GDP and the explanatory variables, including EMPI, IMGS, EXGS, EDUEXP, AI, and ME. Refer Table 5

Table 6: Granger Causality Test

Null Hypothesis	F-Statistic	p-value	Conclusion
lnEMPI does not Granger Cause lnGDP	4.920	0.015	Yes (at 5%)
lnIMGS does not Granger Cause lnGDP	2.110	0.129	No
lnEXGS does not Granger Cause lnGDP	5.814	0.010	Yes (at 5%)
lnEDUEXP does not Granger Cause lnGDP	3.992	0.031	Yes (at 5%)
lnAI does not Granger Cause lnGDP	0.887	0.356	No
lnME does not Granger Cause lnGDP	0.091	0.763	No
lnGDP does not Granger Cause lnME	8.517	0.008	Yes (at 1%)

The null hypothesis of lnGDP does not Granger cause lnME is rejected at 1% level of alpha which means economic growth of the selected country Granger causes military expenditure. In other words, a change in economic growth in the country may lead to a change in military

International Journal of Law, Government and Communication
IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005
expenditure. According to Granger causality results, there is no causal relationship running from military expenditure to economic growth. So, there is a unidirectional relationship running from GDP to military expenditure and any bidirectional relationship isn't observed in the current study. Refer Table 7 for the summary of the results

Table 7: Summary of The Result

Variable	ME → GDP (p-value)	Causality ME → GDP	GDP → ME (p-value)	Causality GDP → ME	Type of Causality
EMPI (Employment)	0.015	Yes (at 5%)			Unidirectional (EMPI → GDP)
IMGS (Imports)	0.129	No			No causality
EXGS (Exports)	0.010	Yes (at 5%)			Unidirectional (EXGS → GDP)
EDUEXP (Education)	0.031	Yes (at 5%)			Unidirectional (EDUEXP → GDP)
AI (Arms Imports)	0.356	No			No causality
ME (Military Exp.)	0.763	No	0.008	Yes (at 1%)	Unidirectional (GDP → ME)

Empirical Findings

The Granger Causality Test results (Table 6) reveal significant causal relationships between exports (lnEXGS), employment (lnEMPI), and education expenditure (lnEDUEXP) with Malaysia's economic growth (lnGDP), all at the 5% level. This underscores the predictive strength of human capital and trade in driving GDP. Notably, lnEXGS ($F = 5.814$, $p = 0.010$) confirms trade as a key growth engine, while lnEMPI and lnEDUEXP highlight the importance of labour productivity and education investment.

In contrast, military expenditure (lnME), arms imports (lnAI), and imports (lnIMGS) show no causal impact on GDP. However, GDP does Granger-cause military spending ($F = 8.517$, $p = 0.008$), suggesting defence budgets are responsive to economic performance rather than drivers of it. This finding aligns with Saudi et al. (2019), indicating military spending has limited short-term economic impact, reinforcing the idea that investing in human capital yields broader returns.

Supportive studies include Yusoff (2004), who found exports and education Granger-cause GDP, and Hussin et al. (2012), who confirm two-way causality between education and economic growth. Likewise, Zhong et al. (2017) observed that GDP influences military expenditure in BRICS and G7 nations, similar to Malaysia's case.

The findings affirm human capital and trade as primary growth drivers. Military expenditure, while crucial for national security, must be strategically aligned with broader development goals. Investing in education, skills, and niche exportable defence technologies defence such as electronics, UAVs, and cyber security defence can enhance Malaysia's defence sector's contribution to economic resilience. According to Ridzuan et al.(2020) the long run elasticities showcased that low inflation and currency appreciation lead towards higher government

International Journal of
Law, Government and Communication
IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005
spending on military expenditure while deepening in trade openness cause lower spending on military. The findings support a strategic shift toward human capital-driven and research and innovation based defence industry to enhance resilience and reduce dependency, as heavy reliance on imported products exposes the economy to inflationary pressures and long-term vulnerabilities.

Conclusion and Recommendations

This study concludes that Human Capital Development (HCD) plays a foundational role in shaping the economic trajectory of Malaysia's defence sector. Through a quantitative analysis using time series data from 1991 to 2023, the study finds that Employment In Industry (EMPI), Education Expenditure (EDUEXP), and Exports Of Goods And Services (EXGS) significantly Granger-cause GDP, indicating that labour productivity and targeted investments in education are vital contributors to national productivity and sustainable economic growth. In contrast, Military Expenditure (ME) and Arms Imports (AI) do not exhibit significant short-run causal effects on GDP, which suggests that Malaysia's defence sector currently lacks the scale, technological depth, and economic integration necessary to generate broader economic spillovers.

These results reinforce the idea that Malaysia's national development depends heavily on the quality of its human capital and the alignment of workforce competencies with industrial demands. While strategic documents like the Defence White Paper (2020) and Twelfth Malaysia Plan emphasise the importance of local capability development, there remains a disconnection between national HCD efforts and the specific requirements of the defence industry. The absence of a coordinated, defence-aligned HCD policy framework has constrained the sector's potential to contribute to innovation-driven growth, technological upgrading, and self-reliant national defence capabilities. International experiences, particularly from developed region demonstrate how HCD have the relationship with industrial strategy through vocational training, applied R&D, and talent management can position the defence industry as a dual engine of national security and economic development. To achieve similar outcomes, Malaysia must adopt a more integrated approach that embeds HCD within its broader defence industrialisation roadmap.

This study recommends the following strategic plan to strengthen Human Capital Development and thereby enhance the economic future of Malaysia's defence industry:

1. Strengthen Defence-Focused Industrial Training and Workforce Development
2. Enhance Public Investment in Technical Education and Dual-Use R&D
3. Promote Defence Export Competitiveness and Local Supply Chain Development
4. Reallocate Military Expenditure Toward Capability and Technology Transfer

Towards advanced, resilient and competitive defence industry, Malaysia must prioritise defence-focused workforce development. Since industrial employment significantly influences GDP, expanding vocational and technical programmes in areas like aerospace, advanced manufacturing, and cybersecurity is critical. This effort requires collaboration between TVET institutions, universities, and key defence players such as STRIDE and DEFTECH.

Next, scaling up education investment and dual-use innovation is vital. With education expenditure shown to Granger-cause GDP, boosting funding for STEM and integrating defence-related content in curricula can enhance innovation capacity. Stronger R&D ties between universities and defence firms in AI, robotics, and avionics will reduce technological dependence.

Third, Malaysia should strengthen defence export competitiveness while developing local supply chains. Given exports have strong relationship with GDP, policies must support defence SMEs with certification, market access, and compliance incentives. Simultaneously, localising key components like electronics and materials will build supply chain resilience. Additionally, reallocating parts of defence budgets toward capability development and tech transfer will yield long-term gains. While defence spending doesn't directly drive GDP, channelling funds into training, simulation, and local content requirements in procurement deals can accelerate innovation and reduce foreign dependency.

Collectively, these strategies can transform Malaysia's defence sector into a dual-purpose engine, safeguarding national security while generating high economic returns through employment creation, industrial upgrading, and technological innovation. While this study underscores the significant role of Human Capital Development (HCD) in enhancing economic performance, its national-level scope may overlook variations across regions, industries, or firm sizes. Future research should incorporate micro level data and comparative analysis with other emerging defence economies to better understand policy effectiveness and cross-sectoral linkages. Ultimately, if Malaysia aspires to build a competitive, self-reliant, and future-ready defence industry, HCD must be strategically positioned at the core of its industrial and fiscal planning. By integrating HCD across workforce development, R&D ecosystems, and institutional policy frameworks, the defence sector can evolve into a resilient contributor to inclusive, innovation ed, and sustainable economic growth.

Acknowledgement
The research presented in this paper was funded by the Ministry of Higher Education Malaysia under the Fundamental Research Grant Scheme (FRGS) Grant No. FRGS/1/2024/SS06/UPNM/02/1. The authors wish to thank the ministry and National Defence University of Malaysia for the support provided.

References

Abdul Aziz, M. A., & Hashim, M. N. (2020). An overview of the Malaysian defence industry and way forward. *International Journal of Academic Research in Business and Social Sciences, 10*(8), 1075–1090. Retrieved from https://www.researchgate.net/publication/343733635

Ahmad, S., & Harnhirun, S. (1996). Cointegration and causality between exports and economic growth: Evidence from the ASEAN countries. *Canadian Journal of Economics, 29*(S1), S413–S416. doi:10.2307/136078

Ahmad, S., & Harnhirun, S. (1996). Export and growth in the ASEAN countries: Causality tests. *Asian Economic Journal, 10*(3), 317–330. Retrieved from https://aei.um.edu.my/

Arifin, N. M., Yusof, Z., & Radam, A. (2011). Economic sectors and growth: Cointegration and causality analysis for Malaysia. *Advanced Science Letters, 4*(1), 400–407. Retrieved from https://www.researchgate.net/publication/267628032

International Journal of Law, Government and Communication
IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005
Balakrishnan, K. (2008). Defence industrialisation in Malaysia: Development challenges and the RMA. *Security Challenges, 4*(4), 135–155. Retrieved from https://www.researchgate.net/publication/26597910

Balakrishnan, N. (2008). Defence expenditure and economic growth in Malaysia: A reassessment using the bounds test approach. *Journal of Economic Cooperation and Development, 29*(1), 1–18.

Barro, R. J. (2001). Human capital and growth. *American Economic Review, 91*(2), 12–17. doi:10.1257/aer.91.2.12

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica, 49*(4), 1057–1072. doi:10.2307/1912517

Economic Planning Unit. (2021). *Twelfth Malaysia Plan, 2021–2025: A prosperous, inclusive, sustainable Malaysia*. Prime Minister's Department. Retrieved from https://www.epu.gov.my

Enders, W. (1995). *Applied econometric time series* (1st ed.). John Wiley & Sons.

Granger, C. W. J. (1988). Some recent developments in a concept of causality. *Journal of Econometrics, 39*(1–2), 199–211. doi:10.1016/0304-4076(88)90045-0

Hanushek, E. A., & Woessmann, L. (2012). Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation. *Journal of Economic Growth, 17*(4), 267–321. doi:10.1007/s10887-012-9081-x

Hirnissa, M. T., Baharom, A. H., & Habibullah, M. S. (2008). Defence spending and economic growth in ASEAN-5 countries. *Asian Academy of Management Journal of Accounting and Finance, 4*(1), 45–66.

Hirnissa, M. T., Habibullah, M. S., & Baharom, A. H. (2008). Military and economic growth in ASEAN-5 countries: A panel approach. *MPRA Paper No. 13108*. University Library of Munich, Germany. Retrieved from https://mpra.ub.uni-muenchen.de/13108/

International Monetary Fund. (1996). *Malaysia: Staff report for the 1996 Article IV consultation (IMF Staff Country Report No. 96/88)*. International Monetary Fund. Retrieved from https://elibrary.imf.org/

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration – with applications to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*(2), 169–210. doi:10.1111/j.1468-0084.1990.mp52002003.x

Katircioglu, S. (2009). Military expenditure and economic growth in Turkey: Evidence from cointegration and causality tests. *Defence and Peace Economics, 20*(1), 1–12. doi:10.1080/10242690701823246

Katircioglu, S., Deliktas, E., & Balcilar, M. (2007). The relationship between electricity consumption and economic growth in Turkey: Further evidence. *Energy Economics, 29*(6), 1151–1160. doi:10.1016/j.eneco.2006.10.011

Lee, C. (2013). The causality between export and economic growth in Malaysia. *Journal of Economic Research, 18*(2), 1–15.

Lee, C. (2013). The role of macroeconomic fundamentals in Malaysian post-recession growth. In M. H. Kamaruddin (Ed.), *Recession and its aftermath: Adjustments in the United States, Europe and the emerging economies* (pp. 113–127). Nova Science Publishers. Retrieved from https://mpra.ub.uni-muenchen.de/44808/

Ministry of Defence Malaysia. (2020). *Defence White Paper: Defending the nation, securing the future*. Retrieved from https://www.mod.gov.my

International Journal of Law, Government and Communication
IJLGC
EISSN : 0128-1763
Volume 10 Issue 42 (December 2025) PP. 56-72
DOI 10.35631/IJLGC.1042005
Nur Surayya Mohd Saudi, Ismail, A., Baker, R., Pinjaman, S., Abdullah, A. N., Rafiuddin, N. M., & Sulaiman, A. (2019). Military expenditure and economic growth: Empirical evidence from Malaysia. *International Journal of Recent Technology and Engineering (IJRTE), 8*, 1–5.

Psacharopoulos, G., & Patrinos, H. A. (2018). Returns to investment in education: A decennial review of the global literature. *Education Economics, 26*(5), 445–458. doi:10.1080/09645292.2018.1484426

Ridzuan, A. R., Ismail, N. W., & Kamarudin, F. (2020). The impact of military expenditure on economic growth in Malaysia: New evidence using nonlinear ARDL approach. *Defence and Peace Economics, 31*(6), 683–696. doi:10.1080/10242694.2019.1568151

Ridzuan, A. R., Ismail, R., & Rahman, R. A. (2020). Macroeconomic determinants of military expenditure in Malaysia. *International Journal of Economic Policy in Emerging Economies, 13*(4), 675–690. Retrieved from https://www.inderscience.com/

Ridzuan, A. R., Shaari, M. S., Nur Surayya Mohd Saudi, Kumaran, V. V., & Md Razak, M. I. (2020). *Macroeconomic determinants of military expenditure in Malaysia*. *International Journal of Economic Policy in Emerging Economies*, *13*(6), 675–690. https://doi.org/10.1504/IJEPEE.2020.111693

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy, 98*(5, Part 2), S71–S102. doi:10.1086/261725

Rusland, S. L., & Saudi, N. S. M. (2023). *Harnessing national defence industry towards resilience & sustainable economy* [Conference paper]. ResearchGate. https://www.researchgate.net/publication/378610698_Harnessing_National_Defence_Industry_Towards_Resilience_Sustainable_Economy

Schultz, T. W. (1961). Investment in human capital. *American Economic Review, 51*(1), 1–17.

World Bank. (2014). *World Development Indicators*. The World Bank. Retrieved from https://databank.worldbank.org/source/world-development-indicators

Yusoff, M. B. (2004). Exports, education and growth in Malaysia. *International Journal of Business and Society, 5*(1), 37–55. Retrieved from https://scispace.com/pdf/exports-education-and-growth-in-malaysia-546nqqcgep.pdf

Zhong, M., Ali, R., & Yusop, Z. (2017). Military expenditure and economic growth: Evidence from BRICS and G7 countries. *Economics, Management and Sustainability*.