Dual-Use Technology in Southeast Asia: Nonproliferation Challenges for the Next Decade

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Abstract

As industrial growth and technological progress continues in Southeast Asia, the region is rapidly becoming the next big provider of proliferation sensitive dual-use commodities. Unlike most traditional suppliers, many countries in Southeast Asia do not have strong strategic trade management systems, a fact that will leave the region open to becoming a hub for WMD proliferation. Based on a review of export statistics, industry projections, and discussions with regional industry experts, a number of key sectors can be identified as particularly challenging: oil and gas, chemicals, aerospace, nuclear energy, electronics, and automobile manufacturing. Other emerging trends like additive manufacturing and the growth of online marketplaces will also impact the ability of the region to manage dual-use commodities. Having a better understanding of how growth in dual-use commodities will progress in the near-term can assist regional leaders and international partners in focusing their attention and limited resources most effectively. Improving regulations and control lists is only one part of the way forward. Creating outreach strategies that fully engage key industries will also play an important role in stemming the illicit spread of sensitive dual-use items from the growing economies of the region.

Keywords

Nonproliferation, export control, strategic trade control, Southeast Asia, weapons of mass destruction

Introduction

Southeast Asian nations are already an essential part of the global trade system. The Association of Southeast Asian Nations (ASEAN) members have a total trade volume of $2.5 trillion in 2014, and about 80 million twenty-foot equivalent units (TEUs)—or 15 percent of total ocean-going containers—pass through ASEAN

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ports annually.[2] The growth rates for the fastest developing economies in the region are expected to average about five percent a year into the next decade. As the economies in the region grow and increase in complexity, Southeast Asian states will play a larger role in the development and trade of sensitive, high-tech commodities—both as customers and manufacturers. The increased prominence of these dual-use commodities in the region points to a need for a strengthened security framework to prevent possible proliferation of sensitive materials to programs, by both state and non-state actors, aimed at developing weapons of mass destruction (WMD).

Concerns about Southeast Asia's place in WMD-related trafficking efforts are not new. Countries in ASEAN have previously been used as both transshipment conduits and manufacturing hubs for WMD trafficking networks. Most notoriously, the nuclear smuggling network of A.Q. Khan employed Southeast Asia-based firms to manufacture centrifuge parts for Libya's nuclear weapons program and utilized ports in the region to transship sensitive commodities. Apart from the Khan network, illicit procurement efforts by Iran and North Korea have used Southeast Asian entities and ports to obtain sensitive dual-use commodities. In many of these transfers, manufacturing firms specializing in sectors such as oil and gas have inadvertently sold dual-use materials to suspect end-users. As the region's capacity to manufacture and export dual-use commodities increases in the coming years, it is more likely that incidents like these will grow in frequency and that the harm they inflict on international security will be more severe. Until very recently, many governments in Southeast Asia did not see a need to focus much attention on the management of dual-use commodities. For many officials, proliferation sensitive technologies were not seen as widely available in the region and controls on trade would therefore be an unnecessary burden on economic development. This notion is now being challenged by the known cases of proliferation activity and the increased manufacturing of dual-use commodities by ASEAN-based firms.

In the last few years, a growing number of countries in ASEAN have paid more attention to the issue of proliferation of dual-use commodities. Singapore was the earliest adopter of a strategic trade management system, followed by Malaysia in 2010. In the Philippines, President Benigno Aquino signed into law the Strategic Trade Management Act (STMA) in November 2015.[3] Thailand is also on the path to having its first regulation of dual-use exports, although the timeline remains unclear. However, many countries in the region—even those noted above—still lack a full understanding of the number and types of domestic industries likely to be using or manufacturing dual-use commodities.

Both regulatory authorities and domestic industries in ASEAN remain unaware of the extent to which locally-based firms can contribute to the proliferation of WMD-related programs. In part this is due to the rapid growth in industries new to the region where proliferation sensitive items are major components for manufacturing and production. These industries include the oil and gas sector, chemical, aerospace, energy (particularly nuclear), electronics, and automobile manufacturing. The management of proliferation sensitive technologies in Southeast Asia is likely to be further challenged by the recent advent of disruptive technologies that traditional supplier countries are still grappling with controlling, like additive manufacturing. All this is made more complicated by the growing popularity of online marketplaces in the region, and the extent to which these portals are able to quickly facilitate exports of proliferation sensitive dual-use commodities from smaller firms less cognizant of the need to control these items.

Using industry projections and export statistics, as well as discussions with regional experts, it is possible to identify likely industries and high-tech sectors in the region that will pose a challenge to strategic trade

[2] Total numbers based on data from: "Table 17 ASEAN Trade, 2013-2014," ASEAN External Trade Statistics, <http://www.asean.org/images/2015/July/external_trade_statistic/table17_asof17June15.pdf>; and "Container Port Traffic," World Bank, <http://data.worldbank.org/indicator/IS.SHP.GOOD.TU>.

[3] Charmie Joy Pagulong, "Noy Signs Law vs. Weapons of Mass Destruction," *Philippine Star,* November 18, 2015. For the full text of the law, see <http://www.gov.ph/2015/11/13/republic-act-no-10697/>.

management and nonproliferation efforts in the next five to ten years. For this research, the author looked mainly at trade and industry data pertaining to the five fastest growing ASEAN economies (based on GDP growth rates)—Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. Singapore, with a GDP per capita significantly higher than its neighbors, has the most mature trade management system. Considering Singapore's unique status in the region—having both established industry sectors with significant dual-use capabilities as well as a relatively advanced trade control system—the author excluded it from the review of projections and export data. Likewise, although Brunei Darussalam has the second highest GDP per capita in ASEAN, its economic complexity ranking falls well below that of its ASEAN neighbors.[4] Brunei's lack of economic complexity is largely due to its complete reliance on oil exports to support its economy.[5] Although the development of dual-use technology in Brunei remains a possibility, its prospects are more akin to the slower growing countries—Cambodia, Lao DPR, and Myanmar—over the next decade.

As is true in traditional supplier countries, including the US, Japan and the EU, Southeast Asian states have to meet the challenge of managing the trade of dual-use commodities with limited resources shared between competing interests. With an improved understanding of how dual-use growth will progress in the near-term, regional leaders and their international partners should be able to focus these limited resources on the most critical sector. With the key industries identified, regional authorities can structure their systems to meet the challenges created by these new and developing sectors. Improving regulations and control lists should be only one part of the way forward. Creating outreach strategies that fully engage the most relevant industries will also play an important role in stemming the illicit spread of sensitive dual-use commodities in the region.

Prospects for ASEAN's Economic and Technological Development

Although growth in ASEAN's top economies can fluctuate from year to year, the overall growth predicted over the next decade is expected to be positive. ASEAN as whole has been the second fastest growing economy in Asia (after China), having seen GDP growth of 300 percent between 2001 and 2013.[6] The ASEAN-6—Singapore, Malaysia, Indonesia, Thailand, the Philippines, Vietnam—have had an average rate of six percent growth over the last five years; similar rates are expected to continue into at least the next five years. This consistent growth is expected to foster technological expansion and sophistication. Based on recent export statistics and discussions with regional experts, it is clear that as these countries develop technologically, the volume of dual-use commodities available in the region will likewise increase.[7]

The entry of more multinational corporations and expansion of foreign direct investment have already increased the level of sophistication in many industrial sectors. ASEAN, particularly the top growth economies, is attractive to many foreign firms due to the presence of a strong manufacturing base and a labor market that is more affordable than other developed Asian countries. Increased interest from outside investors will only speed up the dual-use capabilities throughout the region. Although specific data on the introduction of dual-use technology is hard to identify, anecdotal evidence based on discussion with regional experts indicates that large multinational firms have already created manufacturing hubs in the region for controlled dual-use commodities.[8]

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[4] The economic complexity index (ECI) measures the diversity of a country's exports – which is typically an indicator of positive economic development in the near future. According to *The Atlas on Economic Complexity,* <http://atlas.cid.harvard.edu/>, Brunei's ECI is -2.543563, whereas in comparison Myanmar's ECI is -1.167571, Thailand's is 0.9931926, and Singapore's is 1.613748.

[5] In 2013, 96 percent of Brunei's exports were petroleum products. See *The Atlas on Economic Complexity,* <http://atlas.cid.harvard.edu/>.

[6] GDP growth rates as calculated by the East-West Center's "Asia Matters For America" site, <http://www.asiamattersforamerica.org/asean/data/gdppercapita>.

[7] Discussions with regional experts at CNS sponsored roundtable discussion "Forecasting Industrial Development & Dual-Use Capabilities in Southeast Asia," September 29, 2015; report forthcoming.

[8] For example, a representative of General Electric working on trade compliance issues in the region noted that GE had facilities

The expansion of both domestic and export markets help explain the strength of ASEAN's economic development, and both will likely promote similar growth in the future. ASEAN is the world's third largest market, based on total population, and the fourth largest exporting region. The economic focus of regional leaders continues to be the full establishment of the ASEAN Economic Community, and related efforts like creation of the ASEAN Single Window, which aims to integrate regional customs agencies and further streamline intra-ASEAN trade.[9] If ASEAN economic integration continues smoothly, the increased ability to trade, invest and move technology across the region is expected to further improve growth throughout the region. Although including the concept of dual-use trade management into these integration efforts has been discussed, it remains a minor part of the overall integration efforts in the region.

It should be noted that many analysts remain skeptical about how much integration will actually occur over the next decade.[10] The wide disparity in development between the ten ASEAN states remains a major challenge for creating a true open market, and institutional weakness is likely to continue to slow economic progress for many countries. However, the fastest growing economies are likely to meet integration goals sooner, spurring further development of high-tech industries in the ASEAN-6 countries in the near to mid-term.

Projected Growth in Dual-Use Sectors

Based on current industry projections and discussions with regional experts, proliferation sensitive sectors expected to grow over the next decade include: oil and gas, chemical, aerospace, nuclear energy, automotive manufacturing, defense products and electronics. In reviewing existing trade data—specifically export statistics from the UN Comtrade database—the growth in many of these sectors over the last five years is clear. Although this data can fluctuate in reliability, and therefore cannot be taken by itself as proof of potential growth, the generally positive correlation with industry projections and the views of regional experts helps provide some validation of the author's forecasts with regard to these dual-use industries.

Another area of proliferation concern is the expected rapid adoption of additive manufacturing technology—commonly referred to as 3-D printing. Although Singapore is currently the main regional driver for this type of disruptive technology, the relevant know-how and equipment is expected to spread relatively quickly throughout the region. The increasing popularity of online marketplaces in the top growing economies in the region is also likely to have an impact on the ability to manage dual-use trade in ASEAN states.[11] The potential influence of these two emerging issues will be reviewed separately at the end of this section.

In order to reconfirm whether these growth industries could produce sensitive dual-use commodities in the region, CNS analyzed available UN Comtrade data on exports of certain categories of items frequently used in these industries. To get a rough estimate of the volume of currently traded proliferation sensitive goods, we analyzed the export of certain categories of items based on their Harmonized System (HS) Code from the selected five countries over the last five years of available data (2009-2014) to chart the overall growth in production. The HS Code system was developed by the World Customs Organization (WCO) and its member states to uniformly categorize commodities traded internationally. HS Code include 5,000

in both Singapore and Indonesia for the manufacture of controlled nickel-alloy clad valves. These valves were specifically intended for oil and gas drilling operations. Discussions at CNS sponsored roundtable discussion "Forecasting Industrial Development & Dual-Use Capabilities in Southeast Asia," September 29, 2015; report forthcoming.

[9] For more on the ASEAN Economic Community, see "ASEAN Economic Community: 12 Things to Know," on the Asian Development Bank website <http://www.adb.org/features/asean-economic-community-12-things-know>. For details on the ASEAN Single Window, see the ASW's official website at <http://asw.asean.org/>.

[10] See D. Pilling, "The Fiction of a Unified South-East Asia," *Australian Financial Review*, December 11, 2015; and Sanchita Basu Das, "The ASEAN Economic Community: A Work in Progress," *The Diplomat*, May 23, 2015, <http://thediplomat.com/2015/05/the-asean-economic-community-a-work-in-progress/>.

[11] Discussions at CNS sponsored roundtable discussion "Forecasting Industrial Development & Dual-Use Capabilities in Southeast Asia," September 29, 2015; report forthcoming.

commodity groups organized in a hierarchy of chapters (two digits), headings (four digits), and subheadings (six digits). Some countries have gone beyond the six digits, having codes that might go to eight or ten digits in order to describe commodities in more detail.[12]

*Table: HS Codes With Likely Dual-Use Implications**

Chapters	Description of Categories of Items
28	Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or isotopes
29	Organic Chemicals
38	Miscellaneous chemical products
70	Glass and glassware
73	Articles of iron and steel
75	Nickel and articles thereof
76	Aluminum and articles thereof
84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof
85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles
88	Aircraft, spacecraft, and parts thereof
90	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof
96	Miscellaneous manufactured articles

*The survey included numerous headings and subheading under each chapter listed that are likely to include dual-use items. Full list of headings and subheadings can be found in the appendix of this article.

The analysis of the data saw a steady, if not always rapid, growth in many categories with potentially proliferation sensitive commodities. Although this result appears to bolster the validity of the analysis based on other data used in our forecasts, it is important to note a number of caveats on the data set we used. Firstly, Comtrade data can be unreliable as countries use different levels of quality control when preparing these statistics and dependability of reporting varies from country to country. Sometimes adjustments need to be made to deal with discrepancies or anomalies. For instance, as this data was being compiled, Vietnam had not yet published statistics for 2014. To deal with this discrepancy, we used Vietnam's 2013 numbers as a proxy for 2014 to get a reasonable estimate of overall growth in the different sectors reviewed.

A second problem with the data set is that the use of HS Codes to identify likely dual-use commodities being traded is still more art than science. Our judgement on which HS headings (four digits) and subheadings (six digits) to analyze in this research was based on previous work done by CNS experts, as well as experts at King's College London, in correlating HS codes with dual-use control lists. The EU's Joint Research Center has also published work on the correlation of HS codes to dual-use controls, which were very helpful for this analysis.[13] Although the four and six digit specifications do allow for some refinement identifying possible dual-use commodities, none of the correlations to proliferation sensitive commodities are perfect and much work is needed to improve the predictive nature of HS codes when looking for controlled commodities. Keeping in mind both the issue of reliability of the Comtrade data and the unprecise nature of the HS code correlation, the ultimate results of this data analysis are an approximation of growth and a proxy of expected

[12] A useful breakdown of the structure of the HS Codes and relevant nomenclature can be found in Appendix 2 of C. Versino, "Dual-use Trade Figures and How they Combine, 2015," European Commission Joint Research Centre, <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC97664/2015.11.19.economicrelevancedualuse_online_version.pdf>.

[13] C. Versino, "Dual-use Trade Figures and How they Combine, 2015," European Commission Joint Research Centre, <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC97664/2015.11.19.economicrelevancedualuse_online_version.pdf>.

progress in the future.

Oil and Gas Sector:

Industries in Southeast Asia related to the oil and gas sector—such as drilling, production, refining, and petrochemicals—are expected to grow, albeit at slower rates than the previous decade, and gain market share over the next decade. While earlier growth was largely tied to investment from foreign companies and joint ventures, growth in the near future is likely to be centered on investments and technical development of local oil companies.[14]

The commodities required for the oil and gas sector can have significant dual-use implications and industries manufacturing for this sector have been previously duped by traffickers' claims that the items would be used for oil and gas production. Categories of commodities that industry experts see as being proliferation sensitive are numerous and include items like:

- Pumps and valves (usable in chemical weapons and nuclear weapons development)
- Specialized lubricants and other chemicals (relevant to chemical weapons development);
- Gyros and guidance systems (used installing pipelines, for instance, but can also be useful in missile development); and
- Drilling equipment including piping (usable in various WMD, particularly nuclear and missile development.)

In the case of the A.Q. Khan network, the Malaysian company Scomi Precision Engineering (SCOPE) manufactured numerous different components including casings, molecular pumps, crash rings, stationary tubes, clamp holders, and flanges. The employees of SCOPE believed the items they were producing were for oil & gas production.[15] Instead, they were used to finish the assembly of centrifuges meant for Libya's uranium enrichment program.

Of the top five growth economies, Malaysia had the most significant increase in the oil and gas sector over the last few years, with foreign investment playing a major role in this growth. Malaysian companies are focusing significant attention on developing liquefied natural gas (LNG) resources. In 2015, Malaysia was the world's second largest exporter of LNG.[16] Petroleum related business accounts for about 20 percent of all government revenue, meaning fluctuations in oil prices can be particularly troubling for country's national budget.[17]

Indonesia is the region's largest oil producer, ranking 20th in the world.[18] However, the country's oil production has slowed over the past few years and some projections point to a decline beginning in 2017. The decline is in part linked to the lack of regulatory reform in the oil and gas sector, which is heavily controlled by Indonesian state entities, as well as a lack of infrastructure improvements that hinder improvements in production capacity. Despite this less than positive outlook, industry analysts note that Indonesia has significant "below-ground potential" which could lead to increase in production if the "business environment

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[14] Business Monitor International, "Industry Trend Analysis - Weak Oil Prices Will Hit Region's Long-Term O&G Production," September 23, 2015, <https://bmo.bmiresearch.com/article/view?article=1101613&iso=%2BA>.

[15] Kenley Butler, "How the Abdul Qadeer Khan Network Circumvented Export Controls," *Asian Export Control Observer*, April/May 2005, <https://www.nonproliferation.org/wp-content/themes/pitch_premium/pdfs/aeco_0504.pdf>.

[16] Business Monitor International, "Industry Trend Analysis - Australian LNG To Erode Malaysia's Market Share," August 27, 2015.

[17] Economist Intelligence Unit, "Country Report: Malaysia," August 2015, <www.eiu.com>.

[18] "Oil and Gas in Indonesia," PwC Indonesia, May 2014, <http://www.pwc.com/id/en/publications/assets/oil_and_gas_guide_2014.pdf>.

improves."[19]

Thailand is the primary oil refiner in the region and is investing heavily in domestic exploration as well as exploration in other countries like Myanmar.[20] However, foreign investment, which is likely needed to expand domestic capacity further, has been hampered by regulatory delays and an uncertain political situation. Gas production has been on the decline over the last few years is likely to continue in that direction in the near future.[21]

Of the five countries surveyed, the Vietnam and the Philippines had the least active oil and gas sectors. The Philippines is a major consumer of oil and gas from its neighbors, receiving almost its entire supply of refined petroleum products from Asia – including about 25 percent from other ASEAN countries.[22] Likewise, Vietnam's oil and gas production has been on the decline in recent years in spite of marked increases in domestic consumption. Vietnam's oil and gas sector is dominated by state-owned Petro Vietnam, which has been seen as a barrier to foreign investment. On the upside, Vietnam is pushing forward with off-shore exploration efforts, despite maritime disputes in the South China Sea.

Although the prospects for consistent growth in this sector are tenuous for ASEAN's top growth economies, most analysts see it remaining as a major area of investment and economic productivity in the region. While production may slow, it is not expected to decline rapidly in the next decade. Additionally, the level of domestic investment placed by all five states surveyed into the oil and gas sector means that the sector will likely continue to play a major role in increasing the presence of dual-use commodities in the year to come, particularly in the manufacturing firms aimed at servicing this sector. This growth in manufacturing will further increase prevalence, as well as indigenous development, of dual-use equipment such as precision machine tools that are also crucial for development of WMD and missile programs.

Chemical Industry

The growth of the chemical industry in the region is in part associated with the growth of the oil and gas sector, as much of the chemical manufacturing taking place is related to petrochemicals. However manufacturing in other sectors, including plastics and basic chemicals, is also on the rise.[23] When looking at export statistics from UN Comtrade, the HS chapters related to controlled and other sensitive chemicals have grown at a relatively steady rate since 2008. These HS chapters include commodities—both chemicals and related equipment—that are controlled for nonproliferation purposes either by the Chemical Weapons Convention or the Australia Group.[24]

Of the five economies surveyed, regional expert saw Malaysia and Thailand as the fastest growing chemical industries, although Indonesia was also expanding rapidly.[25] As the production of the most proliferation

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[19] Business Monitor International, "BMI Industry View - Indonesia - Q4 2015," August 15, 2015, <https://bmo.bmiresearch.com/article/view?article=1086719&iso=ID>.

[20] "Thailand Economy: Thai Businesses Spread their Wings," Economist Intelligence Unit, 2015.

[21] "BMI Industry View - Thailand - Q1 2016," November 20 2015, <https://bmo.bmiresearch.com.proxy.miis.edu/sar/reports/view?issue=20160101&productid=148>.

[22] See "Where did the Philippines Import Petroleum Oils, Refined from in 2013?," <http://atlas.cid.harvard.edu/explore/tree_map/import/phl/show/2710/2013/>.

[23] "Basic chemicals" are produced in large quantities for industrial needs and are traded within the chemical industry before becoming a final product for the general consumer. See definition at *The Essential Chemical Industry Online*, <http://www.essentialchemicalindustry.org/chemicals.html>. Some basic chemicals are controlled under the Australia Group and/or the Chemical Weapons Convention (CWC) Schedule 3.

[24] The CWC is the multilateral treaty which bans the development and use of chemical weapons. The Australia Group is the multilateral export control regime that focuses on chemical and biological related materials. Both the CWC and AG have lists of items that should be subject to trade controls for nonproliferation reasons. All ASEAN members are also parties to the CWC; a number of ASEAN members, particularly Singapore and Malaysia, also include AG lists in their controls.

[25] Discussions at CNS sponsored roundtable discussion "Forecasting Industrial Development & Dual-Use Capabilities in

sensitive chemicals are controlled by the Chemical Weapons Convention (CWC), of which all ASEAN states are members, a number of industries in the region are already aware of the need to control those commodities. However, many small and medium size enterprises (SMEs) in the region, including in the top growing countries, are less cognizant of the potential security impact of their products. Additionally, many companies remain unfamiliar with controls on dual-use equipment, which although covered by the Australia Group is not covered by the more universally accepted CWC.

For Malaysia, the largest chemical producer in ASEAN, chemicals and related commodities comprise the second largest share of manufactured exports. As noted by Malaysia's trade promotion agency, the chemical industry is directly linked to other key sectors in the economy, including automotive, electronics, pharmaceutical and construction.[26] The petrochemical industry in Malaysia in particular is expanding with new facilities being added by both domestic and international chemical firms.[27] Other parts of Malaysia's chemical industry are also expanding, including in the manufacture of plastics, industrial gases, and specialty chemicals.[28] All of these sectors include not only chemicals that are dual-use in nature, like phosgene or perfluoroisobutene (PFIB), but also require use of specialized equipment needed for CW and other WMD programs, including reaction vessels and distillation columns.[29]

As the primary oil refiner in the region along with an extensive petrochemical industry, Thailand is the second largest chemical producer in ASEAN. The country has increased the export of chemicals and the petrochemical industry has increased the capacity to produce polymers and olefins. Domestic consumption of polymers, which have potential dual-use characteristics, are also expected to increase over the next five years.[30]

Indonesia's chemical industry ranks third behind Malaysia and Thailand in size. However, the government sees the chemical industry as an important area for increased investment. To attract foreign and domestic investment in this sector, it has offered tax incentives and strengthening the chemical manufacturing sector is part of the government's overall industrialization strategy. Indonesia's domestic chemical industry currently includes manufacturers of petrochemical, inorganics, and agrochemicals. As with Malaysia and Thailand, Indonesia's manufacturing is dominated by petrochemicals, although industry experts expect other sectors to grow in the near term. Indonesian experts specifically noted agrochemicals as an area of growth where dual-use chemicals were likely to be used or produced.[31]

Chemical-related commodities make up about three percent of exports from the Philippines, a significantly smaller share than ASEAN's top chemical producers.[32] Philippine manufacturing of basic chemicals is on the increase, however, as is output of chemicals related to plastic and rubber production.[33] Recent production of polymers is also on the increase, spurred on by industries like automotive parts manufacturing. However,

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Southeast Asia," September 29, 2015; report forthcoming.

[26] "Chemicals & Chemical Products," Chemical Unit, Trade and Services Promotion Division, MATRADE website, <http://www.matrade.gov.my/en/foriegn-buyers-section/69-industry-write-up--products/519-chemicals-a-chemical-products>.

[27] Business Monitor International, "BMI Industry View - Malaysia – 2016," November 24, 2015.

[28] Foo, Dominic C Y, P.E., Ceng, "The Malaysian Chemicals Industry: From Commodities to Manufacturing," *Chemical Engineering Progress*, November 2015.

[29] Phosgene is used to make plastics and pesticides, but is also a precursor for chemical weapons and controlled under the CWC and the Australia Group. The industrial gas PFIB is similarly controlled as it is a choking agent; in industry it is widely used in semi-conductor manufacturing and is a byproduct in the production of Teflon. Equipment like reaction vessels and distillations columns is critical to development of these and many other chemicals. Many of them are also controlled under the Australia Group due to their use in the development of chemical weapons.

[30] Business Monitor International, "Industry Trends And Developments - Thailand - Q1 2016 – Petrochemicals," November 25, 2015.

[31] Discussions at CNS sponsored roundtable discussion "Forecasting Industrial Development & Dual-Use Capabilities in Southeast Asia," September 29, 2015; report forthcoming.

[32] Based on 2013 statistics available from *The Atlas of Economic Complexity,* <http://atlas.cid.harvard.edu/>.

[33] Business Monitor International, "Industry Forecast - Philippines - Q4 2015," September 11, 2015.

analysts feel that Philippine capabilities in polymers are underutilized, which may slow growth in the industry overall.[34]

Vietnam's chemical industry remains small in comparison to other sectors in the country, but recent projections show a potential annual growth rate of six percent. With a new refinery coming online by 2017, operated by Nghi Son Refinery & Petrochemical and Vung Ro Petroleum, Vietnam's petrochemical capacity is expected to significantly increase. With this increase, Vietnam could become a self-sufficient producer of many basic chemicals, although there are also fears that Vietnam's progress might result in an overproduction in the region.[35] Although chemical-related commodities hover about six percent of the total exports, the government recently approved restructuring plans for the industry that aims specifically at increasing exports in this sector and modernizing Vietnam's chemical manufacturing.[36]

Aerospace

Beginning in the late 2000s, leading multinational companies began working with aircraft maintenance and aerospace-related manufacturing industries in a number of Southeast Asian states. Boeing, for instance, began sourcing some of its spare parts, assembly and maintenance services from manufacturing centers in the ASEAN-6 economies. The Asia Pacific region is set to be the largest market for new commercial aircraft with orders expected to reach 12,820 units by 2032.[37] Much of that production will likely be sourced locally by multinational firms relying on regionally based suppliers.

Dual-use commodities are ubiquitous in the aerospace industry. Common components from civilian aircraft manufacturing can also be used in military programs, particularly missile related development. The precision equipment needed for manufacturing is also dual-use in nature, and can be used for both missile and nuclear programs. Even maintenance and assembly services, the least specialized of the sub-sectors found in ASEAN, require equipment and engineering capabilities that could contribute to ballistic missile development. As domestic firms become more integrated into the global aerospace supply chain, they will require more precision equipment that until recently has been largely in the hands of traditional suppliers.

Thailand has offered significant incentives to help foster its aerospace industry, including exemptions on import duties and corporate tax exemptions.[38] Rolls Royce works with a number of Thai companies to supply parts and according to a recent interview with a top Rolls Royce executive, Thailand's "strong industrial foundation, good airports and skilled labor" play a major role in the country's success.[39] The draw of Thailand for aerospace related production is also based on its long-standing reputation as a central airplane maintenance center.

Similar to Thailand, Malaysia has offered incentives and provided a good infrastructure for aerospace firms to invest. Malaysia's aerospace manufacturing capabilities are also likely to benefit from its investment in military aircraft from Boeing. As part of that deal, Malaysia expects to be able to "spin-off" technologies to the civilian aviation sector. Malaysia expects these types of projects to allow them to gain access to

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[34] Business Monitor International, "Philippines Petrochemicals Report," *Philippines Petrochemicals Quarterly*, January 2016.

[35] Business Monitor International, "Industry Forecast - Refining - Vietnam - Q1 2016," November 24, 2015, <https://bmo.bmiresearch.com/article/view?article=1071170&advanced_search=1&matches=6983&page=2&position=4&keyword=southeast%20asia>.

[36] "Vietnam: Chemical Sector Restructuring to Boost Exports," *Asia News Monitor*, October 7, 2015.

[37] "Aerospace," Malaysian Investment Development Authority, <http://www.mida.gov.my/home/aerospace/posts/>.

[38] "Aerospace Industry," Thailand Board of Investment North America, <http://www.thinkasiainvestthailand.com/web/en-investment-opportunity.php?id=2>.

[39] See "ASEAN Aerospace gets Global & National Level Push; Boeing & Rolls Royce Spur Know How," <https://aseaneconomist.wordpress.com/2013/01/03/asean-aerospace-gets-global-national-level-push-boeing-rolls-royce-spurs-development-of-local-knowhow/>.

specialized aerospace technologies.[40] Malaysia is already a hub for assembling aerospace components and includes manufacturing repair and overhaul (MRO) activities, as well as design and development.[41]

The Indonesia's aerospace industry received a significant boost when PT Dirgantara Indonesia (PTDI) won an Airbus contract to supply wing parts for the A380 airliner.[42] More recently, in early 2015, Airbus announced plans to shift its production and assembly of the C295 military transport aircraft to West Java capital Bandung from its existing factory in Spain. A recent deal with Indonesian based RAI, which has ties to the family of former President Habibie, will see PTDI design and build an indigenous aircraft.

Vietnam has a number of projects with Boeing and Airbus aimed at increasing their capacity in aerospace manufacturing but the progress is slower than many of its neighbors. The Philippines has so far been the least successful in the aerospace sector in comparison with the other top five growing states in ASEAN; however, Manila is expecting some growth in the aerospace sector over the next decade. Aerospace accounted for just 0.15 percent of Philippine GDP in 2013 but the government expects a modest rise to 0.57 percent by 2020.[43]

Nuclear Energy

The top growing economies in ASEAN have all shown some interest in nuclear energy, although the plans and capabilities of Vietnam and Indonesia are more concrete than the other three countries reviewed here. The ASEAN states most interested in nuclear power are working closely with international nuclear suppliers and any transfer of equipment and technology will likely require IAEA safeguards, making diversion less likely. However, as these projects develop, the components and equipment that are needed to service the construction and operation of the imported reactors will require some level of indigenous industry involvement. As such, companies in the region may begin to manufacture components and parts for nuclear facilities in the near to mid-term, including dual-use components such as valves, pumps and piping. These firms could therefore potentially become suppliers of dual-use nuclear materials to illicit WMD networks outside the region.

Within ASEAN, Vietnam appears to be the fastest growing with four reactors planned, the first expected to go on line by 2025. Vietnam is working with numerous nuclear suppliers to complete its planned reactors, particularly with firms in Japan and Russia.[44] In early 2014, the Vietnam-based Doosan Vina was certified by the American Society of Mechanical Engineers (ASME) to manufacture certain equipment for nuclear power plants. Doosan Vina, the Vietnamese arm of a large South Korean manufacturing company, was the first firm in Southeast Asia to get this type of accreditation which signifies that the company's quality assurance programs meet the high levels required for products used by nuclear industry.[45]

In Indonesia, domestic interest in nuclear energy is mixed, but even with some popular push back based on environmental, safety and security concerns, nuclear authorities are intent on development of civilian nuclear capabilities. The National Nuclear Energy Agency of Indonesia, generally referred to by its Indonesian acronym BATAN, operates three research reactors. These facilities are used to support the development of

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[40] Mikhail Raj Abdullah, "Boeing's Partnership In Malaysia To Have Substantial Spin-offs In Transforming Aerospace Sector," *Bernama*, October 12, 2012, <http://aviation.bernama.com/news.php?id=701412&lang=en>.

[41] "Aerospace," Malaysian Investment Development Authority (MIDA), 2015, <http://www.mida.gov.my/home/aerospace/posts/>.

[42] "On a Wing and a Prayer," *Economist,* February 15, 2014, <http://www.economist.com/news/business/21596589-state-aerospace-firm-risks-forgetting-lessons-asian-crisis-wing-and-prayer>.

[43] "Aerospace," Philippine Department of Trade and Industry website, <http://industry.gov.ph/industry/aerospace/>.

[44] "Nuclear Power in Vietnam," World Nuclear Association website, October 2015, <http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/Vietnam/>.

[45] "Doosan Vina Celebrates N-Stamp," *World Nuclear News*, April 3, 2014, <http://www.world-nuclear-news.org/C-Doosan-Vina-celebrates-N-stamp-0304147.html>.

nuclear energy in the country as well as the production of medical and industrial radioisotopes. Indonesia's nuclear authorities also have facilities focusing on fuel fabrication at a laboratory scale.

Malaysia appears interested in nuclear energy, but its efforts remain in the planning stages. In 2014, Malaysia announced its desire to develop nuclear energy by 2025 and have three to four reactors providing about 15 percent of the nation's electricity by 2030. Although that timeline is likely to slip, the Malaysia Nuclear Power Corporation (MNPC) appears to be moving forward with plans, including having discussions with foreign reactor suppliers, despite continuing public concerns about the safety of nuclear power.[46]

Thailand is not strongly committed to developing nuclear power in the near term, although officials have stated that nuclear energy needs to be considered in the long run if the country is going to move away from fossil fuels. Thailand's interest in nuclear energy was significantly impacted by the Fukushima crisis; the government reacted by delaying the potential start date of construction of a nuclear power plant until 2026.[47] The Philippines has also shown little consistent interest in renewing a nuclear power program, although the country's Department of Energy noted a plan to look into reinstating the mothballed Bataan nuclear plant that was built in the 1980s but never went online.

Defense Products

The global "Revolution in Military Affairs" that began in the early 1990s has also influenced defense and economic developments in ASEAN. The purposeful merging of military and industrial applications within defense development has become increasingly common within ASEAN, particularly in Singapore, Malaysia and Indonesia where indigenous investment in military technology is significant. This method is seen as increasing efficiencies and assuring that investments in defense industries payoff on the commercial side as well. The "spinning off" of military into commercial sectors is prominent in aviation and electronic sectors in particular, however, numerous other high-tech sectors benefit from investment in the defense sector. Many actors in the region see investment in indigenous capabilities as more lucrative and sustainable if military technologies can be directly spun off to commercial projects.[48]

Of the five economies reviewed here, Indonesia has shown the most interest in spinning off defense developments into the commercial sector. In an effort to modernize its military, Indonesia is expected to double its defense budget in the next year, with some of the increased procurement focusing on local industries, although imports and foreign partnerships will still be required to further modernization efforts. Indonesia's three domestic defense producers have been developing products for export to other countries in the region.[49] Although much of the current effort remains strictly focused on military products, defense firms like PT Dirgantara Indonesia—which focuses on aerospace manufacturing—develops and manufactures both civilian and military aircraft.

While the defense manufacturing sector in Malaysia remains small, it is showing signs of growth. Local firms are increasing their technological capacities under cooperative arrangements and joint ventures with foreign firms which have resulted in increased indigenous production of various defense items including unmanned aerial vehicles (UAVs). Slow growth is expected through the end of this decade as the defense industrial base remains nascent. However, the Malaysian government is looking to invest heavily in its defense industry, partially in hopes of improving overall manufacturing and product development

[46] Sheridan Mahavera, "Malaysia's Nuclear Power Plant Not a Done Deal, Says Atomic Power Body," *Malaysian Insider,* May 19, 2015, <http://www.themalaysianinsider.com/malaysia/article/malaysias-nuclear-power-plant-not-a-done-deal-says-atomic-power-body>.

[47] Business Monitor International, "Industry Forecast - Energy & Utilities Infrastructure - Q1 2016," November 2015.

[48] Presentation by Ms. Curie Maharanie, BINUS University, Jakarta, September 2015, at CNS sponsored roundtable discussion "Forecasting Industrial Development & Dual-Use Capabilities in Southeast Asia," September 29, 2015.

[49] Business Monitor International, "Indonesia Defence & Security Report 2015," October 2015.

capabilities.[50]

Electronics

Regional experts point to the electronics sector as a significant area of expected growth in the years to come.[51] The electronics industry is already quite substantial in the fastest growing economies in ASEAN, but their growth and sophistication is expected to increase over the next decade. ASEAN manufactures a significant amount of the world's consumer electronics including 80 percent of the world's hard drives.[52] The strength of ASEAN in this sector is largely due to the region's relatively lower manufacturing costs and positive financial incentives offered by governments.[53] Throughout the region, multinationals have set-up manufacturing facilities for a number of consumer electronics. The transfer of technology occurring in this process is improving overall manufacturing capacity in the region. Local firms are likely to acquire more dual-use commodities to further advance the region's electronics sector, including production equipment, like isostatic presses, and testing equipment, like oscilloscopes, frequency changers and mass spectrometers. Likewise as local firms take on more advanced manufacturing, the electronics they produce will have increased dual-use implications, particularly commodities like microprocessors, capacitors, and spark gaps.

In Malaysia, the electronics industry accounts for about 25 percent of manufacturing output and 33 percent of total exports. Malaysia has shown particular strength in the hardware and semiconductor sector, although appears to be slipping in strength in the electronics and electrical services sector.[54] The Malaysian government has identified the electronics sector as one of the National Key Economic Areas (NKEAs) "to help the country to attain high-income status by 2020."

Thailand is a major electronics exporter and is an important global source of components for hard drives and circuit boards. Numerous multinational companies, including Samsung, LG, Toshiba and Sharp, have a manufacturing presence in Thailand, lured by the lower average wages and government tax incentives. Although multinationals have dominated until now, domestic companies, like Hana Microelectronics, are beginning to have a foothold.[55] The electronics sector currently accounts for about 15 percent of Thailand's export market. Some analysts fear that the Thai electronics market is losing market share to even lower wage countries in the region. In an effort to maintain the lucrative export market, Thailand-based firms are looking at producing more advanced electronics like converters for hybrid cars.[56]

As noted above, the lower wage countries of Indonesia, Vietnam and the Philippines are seeing increased opportunities to grow in this sector as manufacturing and assembly plants are relocated from China and elsewhere.[57] Industry analysts predict a five percent annual growth rate in electronics manufacturing in Indonesia, while Vietnam and the Philippines will see even faster growth at 7.5 percent.[58]
Although Thailand and Malaysia are expected to be priced out of some of the consumer electronics market,

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[50] Business Monitor International, "Market Overview - Malaysia – 2015," November 2015.

[51] Discussion with regional experts at CNS sponsored roundtable discussion "Forecasting Industrial Development & Dual-Use Capabilities in Southeast Asia," September 29, 2015.

[52] "Electronics," Invest in ASEAN website, <http://investasean.asean.org/index.php/page/view/electronics>.

[53] Kan Matsuzaki, "Electronics Industry, Organizing and Fighting Against Precarious Work," IndustriALL website, May 19, 2015, <http://www.industriall-union.org/report-electronics-industry-organizing-and-fighting-against-precarious-work>.

[54] "Malaysia Economy: Electronics Industry in Need of Reboot," *EIU ViewsWire*, November 27, 2015.

[55] Business Monitor International, "Thailand Consumer Electronics Report," January 2016.

[56] Orathai Sriring & Pairat Temphairojana, "Thailand's Outdated Tech Sector Casts Cloud Over Economy," *Reuters*, March 18, 2015, <http://www.reuters.com/article/us-thailand-economy-electronics-idUSKBN0ME2S620150318>.

[57] "ASEAN: Electronics industry competition will grow," Oxford Analytica Daily Brief, April 02, 2015, <https://www.oxan.com/display.aspx?ItemID=DB198734>.

[58] See Business Monitor International, "Indonesia Consumer Electronics Report - Q3 2015," and Global industry forecasts, "Electronics and Computers: Industry Forecasts," Oxford Economics Ltd. (2015).

their focus on higher-end and advanced products will likely continue to foster some growth in the sector overall. As alluded to above, the more advanced the electronics industry becomes in these countries, the more likely they are to require proliferation sensitive commodities for production and be able to produce items that can assist in the development WMD and missiles programs.

Automotive Manufacturing

The automotive industry, and the auxiliary industries supporting this sector, has improved engineering and technological capabilities in a number of ASEAN countries. Manufacturing facilities for automobiles, particularly cars with advanced systems, require numerous pieces of dual-use equipment and commodities. These dual-use products include items like precision machine tools and isostatic presses that can also be used to manufacture components for missile or nuclear programs, or sensitive chemicals products like polymers which have components that can be used for production of chemical weapons. Materials required for automotive production, particularly carbon fiber and high strength steel, are also dual-use commodities that are particularly useful in WMD programs.[59]

Malaysia's national car brands—Proton and Perodua—have been relatively successful, in part due to government efforts to bolster the industry by imposing tariffs against imported vehicles. These two brands, although now threatened by competition as Malaysia's protectionist policies loosen, helped create a strong local production base for Malaysia's manufacturing sector.[60] In 2014, Malaysia introduced the National Automotive Policy (NAP) which included targeted incentives aimed at promoting the expansion of the country's automotive industry, particularly in the production of energy efficient vehicles. Malaysia has also consistently encouraged domestic and foreign investment in the manufacturing of critical components (engines, transmissions, and chassis), auto electronic components (engine management system and vehicle intelligence system), modular manufacture/system integration, and research and development aimed at enhancing domestic technical skills and engineering capabilities.[61]

Indonesia's automotive industry is primarily focused on the manufacturing of budget passenger vehicles and motorcycles for domestic sale.[62] However, more sophisticated product lines, including high-end manufactures like Mercedes, are now assembled fully in Indonesia. Japanese carmakers like Toyota and Suzuki have recently increased their investments in the manufacturing capacity of their Indonesian facilities. Analysts believe the increased output will result in higher automotive exports from Indonesia, particularly to other parts of Southeast Asia. Malaysia's carmaker Proton is currently in discussions with Indonesia's PT Adiperkasa Citra Lestari (ACL) to create a joint venture aimed at developing Indonesia's first indigenous car brand. If this deal were to go through and development were to be successful, Indonesia's auto sector would increase in sophistication and capability.[63]

Thailand is also considered a major auto manufacturing hub. Automotive related commodities, including vehicles and related parts, account for about 12 percent of Thailand's exports.[64] Most recently, the Thai government has looked toward electric vehicles as the next growth segment for this industry and some

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[59] In one example illustrating the extent of the dual-use challenges from automotive manufacturing, an Iranian-connected firm took over an automotive production plant in Germany as an apparent front for obtaining number of sensitive items, including carbon fiber, precision machine tools and high strength steel, likely for ultimate use in building uranium centrifuges. See Michael Birnbaum and Joby Warrick, "A mysterious Iranian-run factory in Germany," *Washington Post,* April 15, 2013, <https://www.washingtonpost.com/world/europe/a-mysterious-iranian-run-factory-in-germany/2013/04/15/92259d7a-a29f-11e2-82bc-511538ae90a4_story.html>.

[60] Business Monitor International, *Malaysia Autos Report - Q1 2016*, (2016).

[61] "Business Opportunity: Malaysia Automotive Industry," *MIDA-Business Opportunity,* August 1, 2010.

[62] "ASEAN: Auto Sector Disunity Implies Competition Danger," OxResearch Daily Brief Service, October 26, 2015.

[63] Business Monitor International, "Indonesia Autos Report - Q4 2015," (2015).

[64] See statistics on Thai exports at <http://atlas.cid.harvard.edu/explore/tree_map/export/tha/all/show/2013/>.

Japanese manufactures appear interested in sharing their production technology and capacity with Thai counterparts.[65] Highlighting how support services for an industry can develop dual-use technologies, growth in Thailand's automotive industry is seen as one likely impetus to the ongoing growth in domestically manufactured machine tools. Automotive and auto parts firms are the customers for about 35 percent of the domestically produced machine tools, including advanced lathes.[66]

Vietnam's role in regional auto manufacturing supply chain is still small but appears to be growing. Vehicle production is on the rise, although not for export. Foreign firms are looking more favorably at Vietnam due to lower production costs than some of its neighbors. However, it is unlikely that Vietnam will transplant the other three big regional players—Malaysia, Indonesia and Thailand—in the near term. This is in part due to the smaller scale of production currently capable in Vietnam, the limited domestic demand and the lack of economic incentives offered by Hanoi.[67]

The Philippines auto industry is currently a relatively small but notable source of manufacturing output for the country—about five percent of the overall total. Industry experts see creating significant growth in this sector as a challenge because of the lack of raw materials, problems with maintaining key testing facilities, and the small domestic market.[68] However, recent government initiatives, including comprehensive automotive resurgence strategy (CARS) program announced by President Aquino earlier this year, aimed to help the industry overcome those challenges. An official from the Philippine Automotive Competitiveness Council noted that small and medium sized enterprises (SMEs) play a major role in the Philippine industry. The CARS program is aimed to further increase the growth of SMEs in this sector as means of creating more skilled jobs.[69]

Emerging Sectors

Aside from the sectors noted above, industry experts also raised concerns about a number of emerging technologies that have potential to grow in the region but are not necessarily being looked at carefully by industry analysts or being captured by trade data. In particular, additive manufacturing was highlighted as an area of growth in the region that could have significant implications on proliferation of sensitive materials.[70] Additive manufacturing (particularly 3D printing with highly specialized metal) can create sophisticated components for use in industry or in military systems. Although the technology is thought to be currently out of reach for many involved with illicit WMD networks, experts are concerned that the proliferation of this technology could be a major challenge to nonproliferation and export control efforts in the near future.[71] In September 2015, a Singapore-based firm Ultra Clean Asia Pacific opened the largest commercial additive manufacturing facility in Southeast Asia. The facility is meant to service a number of key growth sectors in the region, including aerospace.[72] Additive manufacturing is seen as a "disruptive" technology by analysts

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[65] T. Pugliese, "Thailand targets EVs for future growth," *Auto Global News,* July 08, 2015.

[66] "Thailand: Machinery - High Demand Amidst Rapid Development," *Asia News Monitor,* September 23, 2015.

[67] Business Monitor International, "Vietnam Autos Report - Q1 2016," (2015).

[68] "Local Automotive Industry to Thrive Despite Challenges, Industry Player Says," *Philippines News Agency (PNA)*, April 24, 2015.

[69] "Aquino Issues Order to Develop Philippines as Regional Automotive Manufacturing Hub," *Xinhua News Agency*, June 2, 2015.

[70] Discussion with regional experts at CNS sponsored roundtable discussion "Forecasting Industrial Development & Dual-Use Capabilities in Southeast Asia," September 29, 2015.

[71] For an initial discussion of how AM can impact nonproliferation see: Matthew Kroenig and Tristan Volpe, "3-D Printing the Bomb? The Nuclear Nonproliferation Challenge," *Washington Quarterly* (Fall 2015), <https://twq.elliott.gwu.edu/sites/twq.elliott.gwu.edu/files/downloads/TWQ_Fall2015_Kroenig-Volpe.pdf>; and Amy Nelson, "The Truth About 3-D Printing and Nuclear Proliferation," WarOntheRocks.com, December 14, 2015, <http://warontherocks.com/2015/12/the-truth-about-3-d-printing-and-nuclear-proliferation/>

[72] "Singapore Opens Southeast Asia's Largest 3D Printing Facility," *IANS English,* September 28, 2015.

in the region, and as more sophisticated printers become affordable, other companies will likely adopt this form of manufacturing for their industries.[73] Although currently only prominent in Singapore, the speed at which additive manufacturing is being adopted globally means that it is likely the technology will become popular in the other top ASEAN economic performers.

The rising popularity of online marketplaces in bolstering exports from regional firms, particularly SMEs, is also as a potential challenge to nonproliferation efforts in ASEAN. SMEs in ASEAN have been moving rapidly to online sales as a means to increase both domestic and foreign markets.[74] The popularity of online marketplaces in ASEAN remains small in comparison to other regions, but the potential growth is significant as countries improve their IT infrastructure. As has occurred in other parts of Asia, including China, Japan and South Korea, as online marketplaces rise in popularity, the level of sophistication of the products being sold on these platforms also increases. Recent analysis of the sale of dual-use materials via global sites like Alibaba and eBay illustrate the challenge these sites can pose to nonproliferation efforts. In the Southeast Asian context, SMEs are using local online platforms to sell their commodities; as the majority of SMEs are unlikely to be aware that products they develop or trade in may be dual-use, this trend can have significant security implications.

Addressing the Security Implications of Dual-Use Commodities in ASEAN

The prevalence of dual-use commodities in ASEAN will grow over the next decade, particularly in the top five growth countries. Although current industry projections may fluctuate in the sectors reviewed, those fluctuations are not likely to severely impede overall technological advancement in the relevant industries. As these industries advance, a framework for managing the resulting growth in dual-use technologies needs to be constructed. As mentioned in the first section of this paper, the initial steps of that framework have been taken by a number of countries, but significant work is still to be done.

While recognizing the need for greater controls as technical capacity grows, some regional experts from industry and academia have raised concerns that increased regulation would not necessarily create more effective systems. At the moment, regional governments are trying to *de-regulate* in an effort to spur development and growth; additional regulations for trade controls at a time when governments are attempting to keep GDP growth steady will continue to be a hard sell in the region.[75] That said, there is also a growing recognition that countries without established trade management systems might be penalized as they try to move up the technological ladder. Domestic companies will be less appealing to foreign high-tech firms if their national trade management systems are not effective in preventing diversion. Companies in the region that are not cognizant of the dual-use implications of the commodities they work with are less likely to attract foreign partners willing to provide, or cooperate on developing, sensitive technologies.

Ultimately, the sooner countries in the region begin creating an effective system and working with the domestic industries that pose the most pressing dual-use challenges, the more likely they will avoid unwanted diversion of their technologies. As trade control authorities in Southeast Asia (and elsewhere) are burdened by competing economic interest and limited resources, they can significantly benefit a greater understanding of what sectors will pose the most challenges domestically. Focusing attention on these sectors will help authorities build and sustain systems in a more efficient and, hopefully, cost effective way.

Below are recommendations for regional authorities and international partners that can further strengthen the existing strategic trade management framework within the region and develop systems better able

[73] "Outlook 2014: Asia Equities," *Asian Investor*, February 2014.

[74] Discussion with regional experts at CNS sponsored roundtable discussion "Forecasting Industrial Development & Dual-Use Capabilities in Southeast Asia," September 29, 2015.

[75] Ibid.

to stem potential proliferation activities in the near to mid-term. These recommendations stem from the projections reviewed above and are specific to dealing with growing dual-use challenges over the next decade, particularly in the top performing countries in ASEAN. These recommendations are not meant to supersede current efforts aimed at fortifying nascent systems in the region. For ASEAN members that do not yet have fully functioning systems with control lists and established procedures, regional and international partners should continue to focus on essentials such as establishing a legal framework, and creating licensing and enforcement authorities. For systems where these essential aspects are still missing, the recommendations below can be integrated into capacity building efforts as the role of dual-use commodities in a given system becomes more prevalent.

- *Regular Monitoring and Analyzing of Trade Data and Independent Industry Projections*

As the outlook on growth in different industries will changes, the needs of strategic trade management systems must change accordingly. Although the projections above are a good basis for policy decisions in the near term, remaining vigilant for shifts in industry that might affect dual-use capacities in Southeast Asia is important to maintaining effective controls in the longer term. Assuring that strategic trade management authorities can obtain and properly utilize detailed analysis of up-to-date trade data would be highly beneficial to assuring their systems stays a step ahead of proliferators. Likewise, assuring their access to unbiased industry projections that highlight emerging industries and technologies will greatly assist strategic trade management officials' ability to steer resources correctly.

International partners, such as the US, EU and others, can support further efforts to improve collection and reporting of trade data in growing economies to assure the data provided is accurate. This could be done in a number of ways, including providing more training on data collection, and better hardware and software for collection and analysis for officials in the growing economies. More attention should also be given to improving the correlation between the HS Codes and dual-use controls, particularly the EU's dual-use control list which many ASEAN states look to when creating their own trade management system.

Regional trade control officials might already have access to government growth projections, and this analysis can be helpful as a basis for policies on industry outreach and licensing. However, government projections can sometimes be impacted by political or bureaucratic pressures and suffer from forecast bias. Internal government forecasts, particularly in many developing economies, might also lack data related to the outlook of trade partners and likely foreign investors. In order to develop a more accurate picture of future industry growth, regional authorities need access to independent and unbiased industry forecasts. Combining improved trade data and independent forecasting would assist regional authorities in creating policies better able to cope with coming challenges

- *Developing Effective Outreach to Most Prevalent Dual-Use Industries*

To establish an effective strategic trade management system, government should strive to have an inclusive and cooperative relationship with the industries most involved with dual-use commodities as early as possible. To balance both the security and economic needs of ASEAN economies, regional authorities and international partners should focus attention on the education of industry, in particularly those noted above, about the security concerns related to dual-use commodities specific to their industries. The use of current trade data and projections can inform these outreach efforts, help identify the sectors of most concern, and tailor outreach for those sectors.

Industry outreach is a vital part of any strategic trade management system and the improvement of these efforts will go far to build up trade compliance in regional companies. Outreach can include: creation of curriculum aimed at creating a compliance culture in domestic firms, publishing clear guidelines to help industry determine their compliance responsibility, and establishment of formal or informal lines of

communication where industry can reach out to licensing officials for questions and clarifications. These outreach methodologies and others that might be seen as beneficial to regional authorities should also highlight the idea that strategic trade management is not just about controlling and stopping trade; complying with international norms on trade in controlled commodities will benefit overall economic growth as foreign firms view more companies in the region as "trusted" trade partners.

- *Engaging Industry Early and Often*

One area that has not been fully developed in ASEAN, even in countries with relatively well established systems like Singapore and Malaysia, is the cooperation between domestic authorities and relevant industry groups. These groups can play a key role in raising awareness on the security challenges posed by the increased prevalence of dual-use commodities. This work could go further than standard industry engagement, which can often be one-way discussions, with governments talking and industry listening. Industry groups can help act as an effective intermediary between companies and the government, and create an effective conduit for relaying industry concerns to government about scope of controls while at the same time giving strategic trade management authorities an avenue for building awareness about the issue. This method would be particularly helpful for reaching small and medium sized enterprises who often look to these industry associations for guidance on regulatory requirements and changing business environments.

Some efforts are already taking place at a nascent level in a number of ASEAN countries, and increased focus on the industries of most concern, such as those noted above, would likely carry numerous benefits. Domestic Chambers of Commerce as well as sector-specific associations are well suited to take a more active role and begin to build understanding within industry for the economic imperative of creating effective trade management systems. By identifying the most vulnerable sectors now, regional governments and international partners can begin outreach to key industries before proliferating entities begin identifying these regional firms as suppliers for their WMD programs.

- *Staying Ahead of Proliferators*

The growing economies of Southeast Asian need to prioritize the management of their dual-use capabilities in order to prevent the region becoming the next major threat to nonproliferation and international security. In order to balance these efforts with competing economic and political interests, regional authorities need to have a comprehensive understanding of which commodities and industries will pose the greatest challenges. The research reviewed here was meant to assist with the prioritization of trade management efforts and look at tools that will help regional officials and their international partners to most effectively use limited resources.

Getting those industries most affected by controls involved early in the process can be critical to removing possible roadblocks to the development of an effective trade managements system. Close collaboration with industry, especially through industry associations or Chambers of Commerce, can allow regional authorities and their international partners to cooperatively develop standards and guidelines for domestic firms that can be practically implemented while at the same time meet domestic and international security needs. As industry will be quick to point out, additional controls and stricter regulation should not be the only answer; cooperative activities combined with controls that target the most sensitive technologies will go far in establishing systems that are sustainable and effective in the decades to come.