MAPPING MANUFACTURERS AND EXPORTERS OF ITEMS LISTED IN THE MODEL ADDITIONAL PROTOCOL ANNEXES FOR OUTREACH ACTIVITIES

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Abstract

Article 2.a of the Model Additional Protocol (AP) requires states to provide data to the IAEA on the manufacture and/or export of a range of nuclear safeguards-relevant materials, equipment, software and technology listed in the AP's Annexes. Member states can use national export control legislation to collect this data. However, manufacturers and exporters can often be involved in the production or international transfer of AP-relevant items without realising the need to track and report such activities, leading them to unwittingly place the member state in breach of its AP obligations.

To better meet their AP obligations, states can engage domestic manufacturers and exporters in awareness raising activities, particularly for those capable of manufacturing and/or exporting AP-relevant items. The goal of such activities is to increase reporting and communication with national competent authorities, allowing for better reporting of AP-relevant activities and for exports of concern to be identified and examined prior to shipment. One key challenge in implementing such activities is ensuring that national competent authorities can reach out to all relevant manufacturers and exporters of AP-related items.

The paper examines how a combination of open and closed data sources can be used to develop and maintain a national map of organisations within a state engaged in manufacturing or exporting activities related to AP implementation. It also provides a series of suggested approaches for outreach activities to raise awareness of how they can become compliant with the national legislation which enables the state to meet its AP reporting obligations. A range of tools and data sources are presented, and their relative strengths and weaknesses are evaluated. These include national corporate data registries, strategic trade analysis products, business-to-business sales platforms, tendering websites, patent databases, company websites, and export licencing data.

1. INTRODUCTION

In 1997, the International Atomic Energy Agency (IAEA) board of governors approved the text of the Model Additional Protocol (AP), a complementary instrument to the three types of safeguards agreement in force with its member states [1]. Over the last 25 years, the AP has strengthened the powers and abilities of the IAEA to carry out its safeguards activities to verify the correctness and completeness of member state declarations. Articles 2.a.(iv) and 2.a.(ix) of the Model Additional Protocol (AP) require states to provide data to the IAEA on the manufacture and/or export of a range of nuclear safeguards-relevant materials, equipment, software and technology listed in the Model AP's annexes [2].

A range of stakeholders are involved in the design, manufacture, sale, export and other handling of AP-relevant items, and unless member states maintain extremely comprehensive records about every private and public entity within their jurisdiction, it is probable that some fraction of these stakeholders will be unknown to national competent authorities. This can place these member states in the position of being unable to fulfil Article 2.a obligations. To address this, states may choose to engage in periodic industry mapping exercises to develop their understanding of national AP-relevant manufacturing and trade activities.

Member states are likely to be already collecting some data of potential use in this exercise through, e.g., business registries and export control licensing information. However, these measures alone do not provide a complete picture. Data in these sources may lack sufficient detail, and manufacturers may not previously have sought to export their products. Furthermore, those that do export may be involved in the production or

international transfer of AP-relevant items without realising the need to track and report such activities. In either case, this can lead them to unwittingly place the member state in breach of its AP obligations.

A truly complete picture will likely always be unachievable given the ever-changing market for many of the items in question. This is particularly challenging given that whilst the Model AP annexes do seek to restrict the scope of the provisions to items specifically designed for use in the nuclear fuel cycle, there remain items within the list with potential non-nuclear applications, known as dual-use items. In addition, many manufacturers may be capable of producing items of AP-relevance as a result of their business activities even if they do not actively do so, and member states may wish to identify these manufacturers for future reference and engagement, even if they do not yet meet the AP reporting thresholds.

Industry mapping activities can be either passive or active, differentiated based on whether they require the analyst to engage with the stakeholders in industry. Whilst passive measures can provide a wealth of useful data, active measures such as awareness raising activities with industry trade bodies can yield much additional information, and a successful mapping strategy will likely require a combination of the two.

Passive mapping methods, based on open and closed sources of data, can be relatively inexpensive to exploit and provide a variety of useful information. In general, these may be divided into government-derived data sources and privately-owned data sources. The former includes corporate registries, export control licensing data, prior nuclear safeguards reporting, and so on. The latter includes data from the open internet, commercially curated databases, physical archives, print publications, and more. A selection of passive mapping methods are discussed in Section 2, with some examples given of data providers, trade websites, and other commercial entities. Please note that these are named purely to illustrate the described sources of data, and the authors do not make any recommendation, endorsement or other indication that any entity herein named is better or worse than any other entity offering similar services, whether named in the paper or not.

Active mapping methods involve direct engagement with stakeholders in industry who produce, sell or otherwise deal with AP-relevant items. This can take many forms, such as the provision of export control advice, direct engagement based on intelligence or law enforcement leads, talks at industry events such as trade association meetings, or one-to-one visits at stakeholders' premises. Active mapping can be relatively expensive compared to passive methods, but can provide a great deal of additional information that is not otherwise readily available. Furthermore, it can be undertaken in parallel with awareness raising activities to engage with stakeholders, thus building their capacity and motivation to engage with mapping activities and proactively report on AP-relevant occurrences. Active mapping methods are discussed in Section 3.

The paper concludes in Section 4 with a reflection on how member states might use a tailored combination of active and passive methods based on their own needs and budgetary situation to carry out industry mapping and improve their AP Article 2.a compliance.

The methods described in the paper are primarily suitable for the identification of manufacturers, sellers and other stakeholders who are not seeking to conceal their activities. In general, they are unlikely to be aware of the risks of their activities or the requirements placed upon them, as opposed to acting purposefully in breach of AP requirements. The responsibility for detecting and dealing with intentional clandestine trade in AP-relevant items should fall to law enforcement, who may use some of the methods described below, but who will have additional techniques that are not herein discussed.

2. PASSIVE MAPPING METHODS

Passive mapping relies on the use of data sources that are available to the analyst without engaging with companies and other organisations of potential interest. The data of use can increasingly be found online, and the review of data sources below is written with this in mind. However, the analyst should never forget that much data continues to be produced and stored in tangible formats, such as printed catalogues and physical records.

2.1 Government-derived data sources

2.1.1 Business registries

Business registries are databases containing information on the corporate entities registered within a given jurisdiction. They are managed by government bodies to maintain the information they require on companies for

taxation, accountability, control, legal and other reasons. The availability and type of data varies between countries, but will typically include basic company particulars (name, address, contact details), a description of the nature of the business, a list of directors and shareholders, and information on company accounts and tax returns. The quantity and quality of the information depends on exactly what is collected, the frequency with which this is updated, and how the accuracy of the information collected from each corporate entity is verified.

Business registries can be useful for industry mapping as they should contain details of all companies in a member state. This includes companies which they have not attempted to engage in international trade, do not have any public-facing presence, or possess no physical or intellectual property. Any legal corporate entity will be listed there, even if they are otherwise absent from other data sources listed in this section.

Business registries often group companies by industry sector, which aids in identifying those which might be AP-relevant. Different countries use various classification systems. For example, Australia and New Zealand use the Australian and New Zealand Standard Industrial Classification (ANZSIC), whilst the United Kingdom uses the UK Standard Industrial Classification (UK SIC). Depending on the organisation of the database, users may use the classification codes or keywords to search for and identify relevant entities. These can then be cross-checked with other sources to determine whether they may produce or sell AP-relevant items.

Corporate business registries are a valuable data source, as they are comprehensive and generally trustworthy. However, the level of accessibility and types of data will vary between countries. While most countries will have a form of an online business registry, some may only have physical copies of company documents, slowing the analyst considerably. Even with an online service, it may be difficult to identify all relevant entities. Some registries may also provide only vague company descriptions, or none at all, making filtering out relevant companies challenging. It may prove time consuming to cross-check to confirm AP-relevant activities, and in cases where a company has little online presence it may not always be possible to confirm details through passive methods, making it necessary to contact the company directly. Finally, companies may accidentally or purposefully submit incorrect information to registries, and so the level of independent data verification must be considered when using this source.

2.1.2   *Export licensing data*

The international trade in AP-relevant items is restricted by the vast majority of IAEA member states to comply with international obligations aimed at reducing the proliferation of nuclear goods, materials and technology. When entities within these states wish to export restricted goods, they must apply for and receive an export licence before doing so. An export licence is a government-issued authorisation for entities to export specific goods or technologies, either as a single export or a recurring activity. When submitting an export licence request, the applicant will be required to include information on themselves, the tangible or intangible item to be exported, and the recipient. Often, information will also be required on the end-use and end-user, if the end-user and recipient differ. The national competent authority will then review the licence application against a range of data they possess, consider the risks that might arise due to the export taking place, and then decide whether the licence should be granted.

Export licence data is commercially sensitive, and decisions may be based on confidential intelligence information. As such, data about company export applications is usually not made publicly available. In the UK, such data was previously accessible through freedom of information requests up until 2016, but the government has since ceased to process such requests [3].

Whilst the data is not publicly available, governments may be able to make use of this closed source data for industry mapping. Data on entities seeking licences to export AP-relevant commodities should be collected as part of industry mapping activities, as it is likely that they possess or have the capability to manufacture AP-relevant goods. However, as mentioned above, this data is commercially sensitive, and will likely have been provided under some assumption of confidentiality. As such, in some member states a legal challenge may be possible to prevent the data being used for another purpose besides export control review. In these cases, permission might be required from the business to share this information for another purpose, and this might dissuade companies from seeking export licences, instead encouraging them to conceal their shipments. A further limitation of this data is that it will only be available for companies who have attempted to secure an export licence. For those who have only traded domestically, or have exported without a licence, they will be unlikely to appear in export licensing datasets.

2.1.3 Intelligence-derived information

Intelligence bodies within governments often monitor for suspected procurement of restricted goods by entities who would use them for illicit purposes, potentially then engaging with law enforcement, customs authorities, or other bodies to halt the transfer. Whilst the details of information received in this way may be heavily restricted, the ability to share the identity of legitimate organisations targeted by illicit actors can help in industry mapping, and may be of particular use in engaging companies who may be at risk.

2.2. Private and open data sources

2.2.1 Transactional trade data

The availability of trade data has increased in recent years, making it a valuable source for AP-relevant mapping of trade in tangible goods, equipment and materials. Trade data encompasses both bulk trade flow statistics, such as are available through the UN Comtrade database [4] or published in the European Commission's Strategic Trade Atlas [5], as well as transactional trade information on specific shipments. The latter is particularly useful for industry mapping, as it often details the goods and parties to the trade. Shipment data is derived from bills of lading, customs declarations and other information submitted to customs agencies and port authorities, and may be accessed through commercial service providers. However, bulk statistical data can still be useful in determining the major imports and exports of potential concern for a given state, allowing for more efficient targeting of other data collection activities.

Commodities are often described using Harmonised System (HS) or similar codes, under which types of commodity can be linked to numerical codes [6]. Searches can thus be run based on these codes. However, the user should be aware that there is not a single HS code for each AP-relevant item, and it is often possible to use incorrect codes wittingly or unwittingly, thus making it challenging to identify shipments of interest amongst the background of millions of daily trade activities through this method.

One example of a commercial provider of trade data is Panjiva [7], a global trade data provider based in the United States, although a range of other providers are available, such as the India-based company Volza [8] or US-based Import Genius [9]. Panjiva collects and combines data from various national customs agencies and other sources. Currently, it offers import and export data from, Brazil, Chile, Colombia, Costa Rica, Ecuador, India, Pakistan, Panama, Paraguay, Peru, Uruguay, the United States, Venezuela and Vietnam [7].

The standard shipment information available through Panjiva includes the following:
— Date of shipment
— Type of shipment (import or export)
— Country of origin, transit, and destination
— Traded item's name, HS code, and description
— Item quantity, weight, and total price in US dollars
— Details of the importer and the exporter (name, address, ultimate owner)
— Packaging type

There are several limitations to using trade data for industry mapping. Countries are not required to report their trade data to commercial providers, which means that for some, it may be impossible to access trade data through these sources. For others, the available trade data may be incomplete and fail to include relevant shipments. To maximise the number of results, analysts may need to use multiple commercial data sources, which may prove costly whilst not guaranteeing that a complete picture of AP-relevant trade will be obtained. The quality of data will also inevitably vary between sources, and the accuracy of the data is very difficult to validate. Data availability may further vary over time. For instance, data creators, such as customs and port authorities, may choose to stop providing data to commercial platforms. Finally, for many items it may not be possible to determine whether the criteria for AP annex listing are met from the shipment data alone. Analysts may thys need to cross-check against information on manufacturers' websites, which is time-consuming and may not always provide definitive conclusions about the item's nature.

2.2.2 E-commerce – Business-to-business and secondary market websites

Business-to-business (B2B) trade is a type of e-commerce where goods and services are exchanged between corporate entities rather than between businesses and individual customers. Through B2B websites, businesses may purchase goods and services they need to support their activities, whilst manufacturers may purchase raw materials and components, or sell their products.

An example of a well-known B2B website is Alibaba [10], a large international trade platform based in China, although numerous other such websites exist, such as Germany-based Europages [11] and India's IndiaMART [12]. One of the world's largest online wholesale marketplaces, Alibaba handles transactions between traders from over 190 countries [13]. Whilst it was created as a B2B platform and still hosts a large amount of B2B trade, Alibaba also services business-to-consumer (B2C) and consumer-to-consumer (C2C) trade. The range of traded products includes machinery, chemicals, and metals and alloys. Alibaba users can use the website's internal search engine to conduct keyword searches. The results can be then filtered by price and supplier country.

B2B websites can provide information on a range of manufacturers and other sellers who do not possess their own websites, who trade in small quantities, or who for whatever reason have decided that the use of B2B marketplaces better suits their business needs. This includes businesses which do not rely on building a long-term brand identity, and instead will cycle through numerous trade names relatively rapidly, a unique though non-negligible segment of industry. In addition, searching these platforms allows the analyst to quickly identify numerous vendors of potentially AP-relevant goods, or suppliers to AP-relevant manufacturers and sellers. In short, B2B websites allow the relatively rapid identification of numerous sellers of items of potential interest, and any industry mapping activity would be incomplete without including these sources.

In contrast to B2B trade, secondary market trade involves the transfer of goods between product end-users, although there is some overlap between B2B and second market sales. Secondary market trade might occur, for instance, where a manufacturer ceases to trade, or upgrades their equipment, and places their existing equipment up for sale to recoup some of its value. Secondary market sales can create additional risks of AP reporting noncompliance, as sales may be less well documented, and traders may undertake fewer due diligence checks than primary manufacturers or sellers, who may better understand the potential AP-relevant uses of the equipment. For instance, a primary end-user of a dual-use item may be using it for a benign, non-nuclear purpose without realising its restricted end-use application, and may transfer ownership of equipment to an organisation intending to use the equipment for AP-relevant purposes. A new company might thus be established and begin trading in AP-relevant goods using equipment acquired solely through secondary market sources, without being noticed by competent authorities. Using secondary market platforms for industry mapping can thus help identify additional manufacturers of AP-relevant items, as well as sellers of relevant items.

A popular example of a secondary market website is eBay, an American e-commerce platform that handles transactions between sellers and buyers in over 190 countries [14]. eBay hosts both primary and secondary trade of items from electronics to industrial supplies. Users can search for items through eBay's internal search engine, and the results can be filtered by an item's location, price, and condition (new or used). Through eBay listings, analysts can collect data on the type and specifications of goods sold in a country, their prices, and information on their original manufacturers and secondary sellers.

While eBay is one of the most popular secondary market platforms worldwide, the sheer number of such websites means that it is unlikely to capture the entirety of the secondary market of AP-relevant items. Searching through all available platforms may prove time-consuming, but analysts can maximise relevant results by identifying those popular within their own countries, including those used for international procurement.

2.2.3 Business directories

Business directories are privately run advertising platforms for companies to establish their online presence and market their products and services. They are particularly useful for companies who do not wish to establish a full website, perhaps due to costs or the niche nature of their offerings, and instead allow them to create a profile where potential customers will search for the types of goods or services they can provide. The searching of business directories can thus help to identify companies which would otherwise have limited online visibility. This is not to say, however, that companies listed in such directories never have other online presences

One example of a business directory is Kompass, a global B2B online directory listing over 53 million companies in over 70 countries and across multiple sectors [15]. Its internal search engine allows users to search for companies, products, services and activities and filter them by location. For industry mapping purposes, the product search feature is particularly useful as it allows to search the key words from the AP list.

Online business directories can prove useful in identifying additional manufacturers of AP-relevant items. However, not all companies use them and so they are unlikely to be an exhaustive source. The type and quality of available data may also vary depending on what business directories require their users to report and the accuracy of the information and product list provided by the companies. As with many of the sources listed here, the business directories may do little due diligence or verification of the information they provide, and users must take care to verify and consult several sources where possible.

2.2.4 Tendering websites

Tendering is the process by which parties in need of goods or services invite potential contractors to submit a bid to provide them. Invitations to tender are often issued by public bodies subject to fair competition rules, but private organisations may also invite potential contractors to tender. Open tenders are advertised freely to all potential contractors, whilst restricted tenders are only open to specific pre-selected parties. Restricted tenders are most often used for sensitive contracts, such as those for military goods or security services. Invitations to tender usually contain specific information about the requested items, and analysing bidders and awarded contractors is useful for industry mapping.

There are multiple ways to access tender notifications, such as through newspapers or government-issued bulletins, but most are accessible online. Governments will often have tendering websites for public contracts. Private sector tenders will most frequently be published on tendering websites. There are many such websites currently online, being either specific to a country and/or an industry, or with global coverage, e.g., Global Tenders [16]. Many websites will require users to create accounts to access their full content, and some charge fees.

The interfaces of tendering websites will vary, but they will usually have a search engine to allow for searching key phrases, and users can filter results by location, bidding deadline, tender value, contracting party name, and other variables. Some tendering platforms that aggregate multiple industries use a system of industry classification. For example, the European Union has developed the Common Procurement Vocabulary (CPV), a system of codes aimed at standardising the contents of the tender notifications. Made up from nine digits, the codes describe the goods or services requested in the contracts – for example, code 35113110-0 describes a nuclear reactor protection system [17].

Tendering websites can be useful tool to identify both manufacturers and purchasers of AP-relevant goods, particularly those who have little public online presence. The level of detail in an invitation to tender is often large, allowing the reader to gain a significant level of understanding of what is being sought. This is complementary to other data sources, which inform more on what companies and other entities exist without necessarily giving full details on their activities. However, as with many data sources, this varies between states and industry sectors, and so analysts will need to take the time to identify relevant sources for their jurisdiction.

Information on entities which have submitted bids, and particularly the bids themselves, can be confidential, which can limit the usefulness of this source. Furthermore, the analyst should not assume that a bid is always indicative of capability – whilst this is often the case, speculative bidders may submit tenders with the intention of developing a capability should they be successful. Nevertheless, this intention is a useful factor to be aware of in industry mapping, as the bidder may become AP-relevant in future.

2.2.5 Patent databases

A patent is a type of intellectual property protection which relies on an inventor to publicly disclose technical and other details of an idea. In return for this, they receive the exclusive right to use the idea and prevent others from doing so without permission within the jurisdiction covered by the patent. Patents signify ownership of an idea, but can be licenced, sold or otherwise transferred [18].

Almost all countries have national patent offices which handle intellectual property rights and issuing of patents [19]. Usually, the patent office's website contains a database that is free to search. Patent databases allow

analysts to identify patent applications for AP-relevant items or modifications to those items together with the details of the applicant, who can be either an individual or a company.

There are also online patent databases that combine data from multiple national patent offices. These are particularly useful when the national database only allows to search for patents by their publication or application number, as is the case in the UK. An example of such a database is Espacenet, a global patent search service developed by the European Patent Office (EPO). Updated daily, Espacenet offers access to over 130 million patent documents through an online search engine [20].

Searching patent databases can be complementary to a wider industry mapping effort but it is unlikely to be sufficient on its own. The ownership of a patent does not indicate capability to manufacture an item, or even that the protected invention is scientifically possible, simply that the idea is protected. Companies may be selling items that they licenced a patent for, as well as items are only covered by a published application (as opposed to an issued patent) or are patented in another country. Finally, where the patent applicant is an individual, it may not always be clear whether they are associated with a company and if they are, which one. To detect potential sellers of the patented invention might therefore require further investigation.

2.2.6 Company websites

Company websites usually contain salient information about a company's particulars, products, and activities. For industry mapping purposes, they can serve as a primary source of manufacturer data, or as an additional source of cross-checking the activities of a company found elsewhere.

Links to companies can be found in various ways. They can be searched for directly, usually through a targeted keyword search of internet search engines, such as Google or national equivalents. When conducting a search, it is useful to do so in the local language or use a Google command that allows to search for websites registered under relevant country domains, for example, using the term "site:.pl" to restrict the search to websites registered using the Poland top level domain. However, the analyst is advised that narrowing down the criteria for the search does risk omitting relevant results – whilst the data collection process will be more time efficient, there is a risk of missing data of interest. Company websites can be accessed through sources such as business directories, secondary market or B2B websites, or tendering websites. Companies will often list their own websites, if they have them, on such sites.

Analysts will usually find two parts of a company website particularly useful. First, the company may list its products and services, which can contain the list of items on offer, their descriptions, pricing information, technical details, and so on. Frequently, companies will include downloadable catalogues, which can give further detail on product specifications. They may also include images of manufacturing facilities. This information may allow the analyst to make deductions regarding capacity and capability to manufacture or otherwise trade in AP-relevant goods and services. Secondly, the 'contact' section of a company's website can include physical addresses, e-mail addresses, telephone numbers, and other information. However, when reviewing information on company websites, the analyst should be mindful of potential errors, omissions or outdated information.

2.2.7 Social Media

In addition, or as an alternative, to maintaining a full website, companies may also have profiles on social media platforms. This might be to engage with potential customers through new channels, build their brand, or advertise their products, for instance. The range of social media platforms is large and constantly changing, with platforms gaining or losing popularity over time and users changing the ways in which they engage with these platforms.

Analysts will need to spend time determining which social media platforms are used within their national context, and how companies make use of them, in order to collect data effectively. Professional social networking platforms, such as LinkedIn [21], offer perhaps the most direct way to identify potential manufacturers and traders in AP-relevant goods and services. However, manufacturers and traders do use a range of other platforms, including those which are not aimed at a solely professional audience. Additionally, companies can post information to social media that they would not place on their own websites, for instance, announcements of new products, photographs of upgrades at factories, and so on. However, the analyst should not rely on this, as such pieces of information are likely to be relatively rare. Furthermore, information can have a relatively short life on

social media before being deleted or simply being subsumed in more recent updates. As such, social media should be treated as a potential source of useful information, but only as a supplement to other sources. In addition, false and misleading information is quite common on social media, and so analysts should not accept information from social media without questioning it.

3. ACTIVE MAPPING METHODS

The passive mapping methods described above can allow for the collection of a range of useful data regarding potentially AP-relevant entities. However, they will always be limited to some degree by the level to which a company engages in international trade, and how much information it proactively puts into the public domain. Whilst an online presence is increasingly important for businesses in the modern world, it is not essential, and so additional approaches are strongly advisable. This is where active mapping methods come in.

Active mapping consists in engaging with identified organisations to draw out additional information, both on the organisations themselves as well as to identify potential additional organisations to be added to the map of AP-relevant companies. This can be conducted through direct outreach to individual entities, as well as through collective outreach via professional and industry associations.

3.1. Direct Engagement with Companies

Following initial collection of data through passive methods on, e.g., a company's activities, particulars, directors and so on, they may be first contacted through an official email, telephone call or similar. When engaged appropriately, companies can become willing and proactive partners in industry mapping activities. As such, any engagement should not be threatening in tone, or otherwise do anything that might cause the company to become defensive or withdraw from the engagement. Company directors with nothing to hide are likely to be intrigued by official communication from government on a security/defence-related matter and will welcome the engagement. Ideally, this would then be followed by an in-person engagement at the company's premises, to discuss the risks, try to persuade the company to work with government openly and put in place any measures to ensure full reporting under the AP can be carried out.

If intelligence-derived information was used in identifying a company as a potential unwitting supplier, this will likely not be something that can be discussed with them in order to protect the sources used by intelligence services. A discussion with intelligence agencies may be required to explore the ramifications of this.

For mapping purposes beyond the entity in question, companies might be asked questions about their competitor organisations, as this will help in the identification of other entities who should be known about, and potentially approached, for AP reporting. Manufacturers and traders will likely be happy to share this information, as they will be reassured that they are not being specifically targeted, nor will they be placed at a disadvantage compared to competitors. They may also be asked about suppliers and even customers, although this must be done carefully and in compliance with national laws regarding commercially sensitive or private personal data.

3.2. Support Services to Manufacturers and Traders

Governments can also support companies to self-report as suppliers of AP-relevant items through engagement and provision of information. For instance, government might make available an export controls advisory service. AP-relevant companies would use such a service to request advice in case of suspicious procurement attempts. For international exporting companies, this service may be complementary to, or already part of, export licensing processes, but it is less likely that a similar service exists to advise of matters related to domestic trade. Engaging with companies will allow government to communicate with AP-relevant organisations about potential threats, and ensure they are informed as to how to identify and handle attempted procurements of concern.

Providing channels through which companies can report concerns, request information, and engage with government creates pathways for AP-relevant organisations to effectively self-identify. However, such services require staff of a certain level of expertise, and so these can be costly unless operated alongside other functions. In general, such a service could be run by, for instance, government export control offices, potentially working in conjunction with intelligence agencies to provide additional information.

Companies must be engaged to communicate the existence of support services, reporting channels and so on. Whilst this can be done directly, as described in Section 3.1, they can also be contacted through national or international industry/trade associations, at industry events, or through professional networks. Governments will need to identify such pathways to communication, and consider the most appropriate combination of channels through which this information can be conveyed to reach the required audience.

3.3. Prioritisation of active mapping activities

The costs of active mapping can be significant, and states will likely need to perform a degree of triage to select those who should receive priority. It is suggested that the key criteria for such prioritisation be:
— capacity and capability to produce or otherwise trade in AP-relevant goods,
— engagement in international trade of AP-relevant goods, and
— whether an intelligence lead has been received of an illicit procurement attempt.

The top priority should be organisations confirmed to both produce and internationally trade in AP-relevant goods. Following this are companies who produce relevant goods but have not yet engaged in international trade. Next, internationally trading companies that produce or sell goods/services whose AP-relevance is in question. Of least priority are companies that both require confirmation of AP relevance and which are not known to engage in international trade. However, where an intelligence lead is provided, the significance of this may be sufficient to push the targeted entity to the top of the priority list, in order to address a known situation without going directly to a law enforcement approach. A heavy-handed response might discourage the company producing or selling the items from engaging openly with mapping activities, and so starting out in this way may be preferable.

In all cases, it is recommended that some active mapping activities do take place – these can provide critical information that is simply not available through passive methods, as well as offering critical opportunities for engagement and improving risk awareness amongst AP-relevant suppliers. As such, active methods should form part of any state's industry mapping activities.

4. CONCLUSIONS

Few states are likely to have the necessary data already available in a form suitable for adequate reporting under Article 2.a of the Model AP. Industry mapping will thus be a vital activity for states to meet their obligations, as a process by which this data can be collected and maintained in a form that lends itself to analysis. The paper has presented two broad approaches to mapping – passive approaches based on data likely to be held by governments or in the public domain, and active approaches based on engaging with industry. Active approaches are likely to be more costly, but will reveal information that passive approaches cannot. Whilst some information on active approaches is given in the paper, the detailed design of these will be heavily driven by specific national contexts and cultures, and there is no single approach that will suit all analytical efforts.

As the discussion of data sources for passive methods demonstrates, it may not always be immediately apparent whether an identified company's products and activities are relevant to the AP. The increasing availability and variety of online information can allow states to identify a greater proportion of the relevant companies, but it can also complicate the information picture. It is thus often necessary to use multiple data sources, to determine both relevance and accuracy of information. Whilst time-consuming, it is important to cross-check information wherever possible.

As a preliminary activity, analysts are recommended to spend some time engaging with the range of potential data sources and developing a detailed understanding of their coverage, reliability, and utility. They will also need to create a suitable list of search terms for each data source and develop a strategy for data collection and analysis. They will need to consider how to develop an effective, yet efficient strategy, balancing the need to collect a sufficiently complete picture against limits of available time and resources. Time invested at this stage into planning, scoping studies and methodology development and testing will pay dividends during data collection and analysis. When collecting and analysing information, the analyst will need to maintain an appropriate degree of caution regarding whether information found is accurate, particularly with regards to data which companies themselves have generated. This can be mitigated through cross-checking of multiple independent sources.

When passive methods reach their endpoint, active methods can produce additional information. However, for active methods in particular, a degree of prioritisation may be necessary to make more effective use of

resources and effectively target outreach activities. This outreach should not threaten or otherwise put in fear its targets, or else the ability to get information will be limited.

The paper has discussed several potential data sources and how they can be used in industry mapping. However, it will fall to member states to develop integrated industry mapping strategies using these and other techniques. The international sharing of expertise and experience in this is recommended, and it may be advisable for the IAEA to be supportive in convening technical meetings, offering training activities and otherwise assisting member states to implement AP-relevant industry mapping most effectively.

ACKNOWLEDGEMENTS

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