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The EMPRISES pan-European Framework:

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Citation:

International Journal of Conceptual Structures and Smart Applications

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RESEARCH ARTICLES

The *International Journal of Conceptual Structures and Smart Applications* is indexed or listed in the following: Cabell's Directories; MediaFinder; The Standard Periodical Directory; Ulrich's Periodicals Directory

The EMPRISES pan-European Framework:
Monitoring and Combatting Serious Organised Economic Crime

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ABSTRACT

There is a need for further integration of information systems globally for tackling Serious Organised Economic Crime (SOEC). Taking Europe as the illustration, and levering existing pan-EU (European Union) systems such as Europol's SIENA and the FIU.NET as well as national systems, further steps can be taken to provide a more coherent and coordinated approach for detecting and deterring SOEC. This aim is achievable through the EMPRISES framework, which adds value to national, SIENA and FIU.NET systems by increasing the effectiveness of communication across Europe. EMPRISES would introduce an agreed common language (taxonomy) of SOEC, including multi-lingual support. Moreover, by enriching the taxonomy with current business tools and analysis techniques through the SOEC Architecture that EMPRISES embodies, the illegitimate businesses of SOEC can be monitored and combatted.

Keywords: Computable General Equilibrium, Conceptual Structures, Data Architecture, Economic Crime, Enterprise Architecture, Europol, Ontology, Organised Crime, Semantic Web, Taxonomy, Transaction Concept

INTRODUCTION

Economic crime, such as fraud, IP infringement, corruption, cybercrime, or accounting fraud continues to be a major concern for organisations of all sizes, across all regions and in virtually every sector (PwC, 2014). Discovering and developing sophisticated new weapons to detect and fight Serious Organised Economic Crime (SOEC) crimes, based on a cooperative and collaborative strategy across nations is thus an imperative. In Europe, each police force and Financial

Intelligence Unit (FIU) presently has its own Financial SOEC monitoring system. To be effective across sectors and regions however requires that these systems are comprehensively integrated into one multilingual pan-European system that at the common European Union (EU) level can then from this singular basis be extended into the global environment. This pan-European system would federate the large volumes of SOEC information from the existing systems and other key sources across the EU, into a single shared inventory of SOEC. This inventory would also be modelled using an agreed pan-European taxonomy of SOEC, capturing even the low-level and low intensity ones, thus giving member states a comprehensive agreed common language. It is in fulfilment of this need that the *Economic criMe PReventIon for a Strengthened European Society* (EMPRISES) has been proposed (Andrews, Polovina, Yates, Akhgar, & Bayerl, 2013; Andrews, et al., 2015). The EMPRISES Framework is the subject of this paper.

SCOPE OF THE PROBLEM

A recent global economic crime survey of 5,128 representatives from over 95 countries around the world was recently conducted. In that survey more than half (54%) of the survey's respondents were employed by organisations with more than 1,000 employees, and over one third (35%) of the survey population represented publicly traded companies. The survey confirmed that economic crime remains a fundamental fact of life for every segment of the global business community. It revealed that over a third (37%) of organisations had experienced economic crime. Nearly half (48%) of respondents reported the risk of cybercrime had increased; a 23% increase from 2011. Amongst its many other statistics, nearly one in five (18%) organisations suffering fraud experienced a financial impact of between US$1 million and US$100 million. The percentage of respondents reporting losses in excess of US$100 million doubled, from one to two per cent (PwC, 2014).

According to the EU Commission, Corruption across the EU is 'breathtaking', costs the EU economy at least €120bn (£99bn) annually, and the "Price of not acting is too high" (BBC, 2014; European Commission, 2014). For one EU Member State, the UK, identified annual fraud losses are now estimated to be £15.5bn; £36.5bn if hidden fraud is considered (National Fraud Authority, 2013). As at December 2013, a mapping of organised crime groups identified some 36,600 organised criminals in 5,300 groups currently operating in ways that directly affect the UK. Organised criminal attacks on the UK's tax regimes were estimated at £4.7 billion in 2011-12. These losses affect the UK's public services, and in helping families and individuals with targeted financial support. Reported fraud against the individual, private and charity sectors is increasing and now affects a large proportion of the UK population, with an overall cost to the UK of approximately £30 billion annually. Small and medium-sized enterprises are less able to absorb the impact of fraud against them and can cease trading (National Crime Agency, 2014).

Additionally, data and methods are not comparable between European countries' existing systems. Some countries use different counting units, each with a different scope which affects the comparability of data between EU Member States. There is a poor definition or non-comparable SOEC definitions at the European level and in context of data collection, and there is a lack of a European common definition and counting units/rules in order to ensure as much comparability. In the field of economic evaluation and State loss of revenue due to SEOC, there are presently significant gaps between "what should be done" and "what is actually possible", with the existing data, at a national level and comparable data across the European Union. There is a need for an overarching, holistic view.

THE ENTERPRISE ARCHITECTURE OF SOEC

SOEC can be portrayed as an Enterprise Architecture (EA), which gives a holistic view of enterprises across its business, economic, social, political, and technological dimensions. What does this mean? Using EA, SOEC are captured as 'business' enterprises just like any legitimate enterprise. The vast body of EA knowledge can then be applied to SOEC. Notably SOEC has the distinction that the transactions it engages in are inherently unbalanced in their favour, as the other parties become victims to those transactions. The victims end up worse off be they individuals, business organisations or society. Put simply, the SOEC enterprises take on board breaking the law as a cost to their 'businesses'. It is this economic risk and its adverse effects to others that distinguish the structure of SOEC from other forms of economic activity. It is through this distinguishing characteristic by which they can be delineated from other business activity, identified and stopped. EA conventionally helps business to identify their strategy-to-operational structure so that they can better understand and align their trading transactions thereby fulfilling their 'mission and vision'. EA can equally apply the very same processes to SOEC, adding this holistic meaning to the data SOEC enterprises generate and thereby discovering their fundamental organisational anatomy. Once explicated, their supply and consumer chains can be identified and trapped, and potential victims alerted.

Figure 1 takes on board the best practices from TOGAF (The Open Group Enterprise Architecture Framework) and appropriates it to SOEC. It reflects the organisation structures of SOEC including its protagonists (the criminal enterprises) and the involuntary agents (i.e. the victims) they transact with, the Local Enforcement Agencies (LEAs), and EU-wide and National Enforcement Bodies.

THE SOEC TRANSACTION CONCEPT

To extend our understanding of SOEC Transactions, the EMPRISES framework incorporates the Transaction Concept from Transaction-Oriented Architecture (Polovina, 2013). The Transaction Concept, based on Resource-Events-Agents (REA) identifies the "real-world" agents in enterprise transactions, how they transact (the Events), and what they transact (the Resources) (Vymětal & Scheller, 2012; Laurier & Poels, 2014). Specifically the resources and events are each called Economic Event and Economic Resource. They therefore embody the Economic Scarcity that highlights the value and the costs of each transaction, and their effect on the Ecosystem. Each Economic Resource in a SOEC transaction however large or petty would thus capture the adverse impact on the EU economies, loss of state revenues, and the overall social and political impact in the wider ecosystem. Such an Economic Event would relate these effects of the illegal exchange of the resources, identifying the victim (individual, corporate or jurisdiction) of the lost resource. Agents in the model are delineated according to their being inside or outside agents. The inside agent is the illicit propagator of the SOEC, and the outside agent the victim. Adding these semantics would distinguish the undesirable from the desirable by the consequences of the transaction. The Transaction Concept also captures the pragmatics as well as semantics of SOEC, thus minimising the impact of 'cat-and-mouse' as the SOEC enterprises try to beat the detection system, because it is the impact that is captured as an economic event or resource rather than the event or resource itself (Stamper, 1996).

Conceptual Graphs (CGs) are a Conceptual Structure that marries the creativity of humans with the productivity of computers, and can be parsed from and to Natural Language (Polovina,

Figure 1. The SOEC Architecture Framework (Adapted from TOGAF, The Open Group Enterprise Architecture Framework (TOGAF, 2011), with permission)
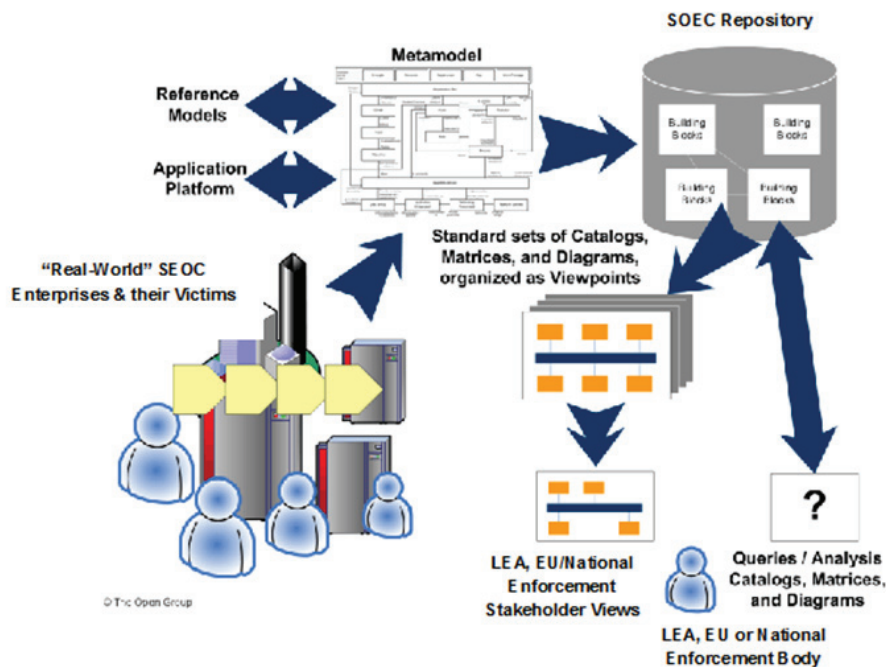
2007). CGs are core to ISO Common Logic (ISO, 2012). CGs would thus be another feature of EMPRISES. Accordingly the TC as a Conceptual Graph (CG) is shown by Figure 2.

Additional rigour to CGs logical-level rigour is provided at the mathematical level by another Conceptual Structure, Formal Concept Analysis (FCA), the value of which has been demonstrated including a conversion from CGs to FCA, CG-FCA (Andrews & Polovina, 2011; Polovina & Andrews, 2013). The Transaction Concept in FCA is represented by the FCA Concept Lattice depicted by **Figure 3**. It reveals that the culmination of the transaction is the Outside Agent, the victim of the Inside Agent (being the illicit propagator of the SOEC as described earlier). Tracing upwards are the Economic Resources and Events involved.

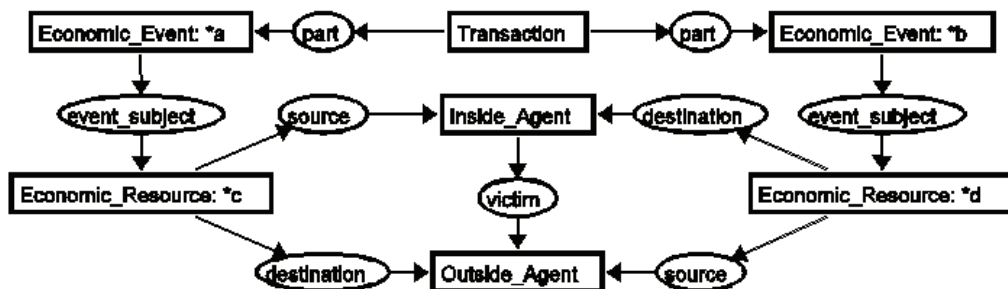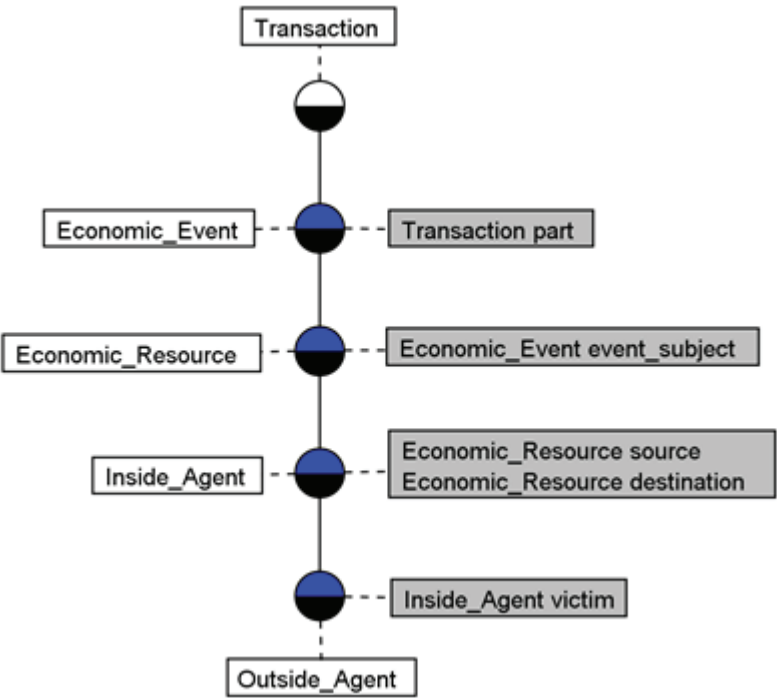*Figure 2. The SOEC Transaction Concept, in CGs*

Figure 3. The SOEC Transaction Concept, in FCA (CG-FCA (Andrews & Polovina, 2011))

There are other uses of FCA in representing organised crime, such as frequent item-sets and associations. An example from drug trafficking is shown by Figure 4 and Figure 5 respectively, and explained elsewhere (Andrews, Akhgar, Yates, Stedmon, & Hirsch, 2013; Andrews, et al., 2015). The figures highlight however how they could be adopted for SOEC. For example, exploring the association between bribery and organised crime groups instead of drug trafficking and violence. Given the common basis in FCA they could then be integrated with the Transaction Concept and EA (Enterprise Architecture, described earlier).

ECONOMIC ANALYSIS

In conjunction with the Transaction Concept, Computable General Equilibrium (CGE) analysis elucidates the direct and indirect economic impact of SOEC (Andrews, et al., 2015; Andrews, Polovina, Yates, Akhgar, & Bayerl, 2013). The CGE economic model fits in closely with the behaviour of SOEC enterprises, their EA, fraudulent transactions, and the derived data monitoring architecture to elicit the EA as and transactions as described earlier. It is referred to in identifying welfare state losses (Turner, 2010). Also, in fiscal studies (Sandmo, 2005; Sennoga, 2006).

E-PEUMS

Pertinent to a Pan-EU Monitoring System (PEUMS) is E-PEUMS (i.e. EMPRISES PEUMS), shown by the solution concept diagram Figure 6.

Figure 4. Visualising OC Activities from Frequent Item-sets (Andrews, Akhgar, Yates, Stedmon, & Hirsch, 2013)
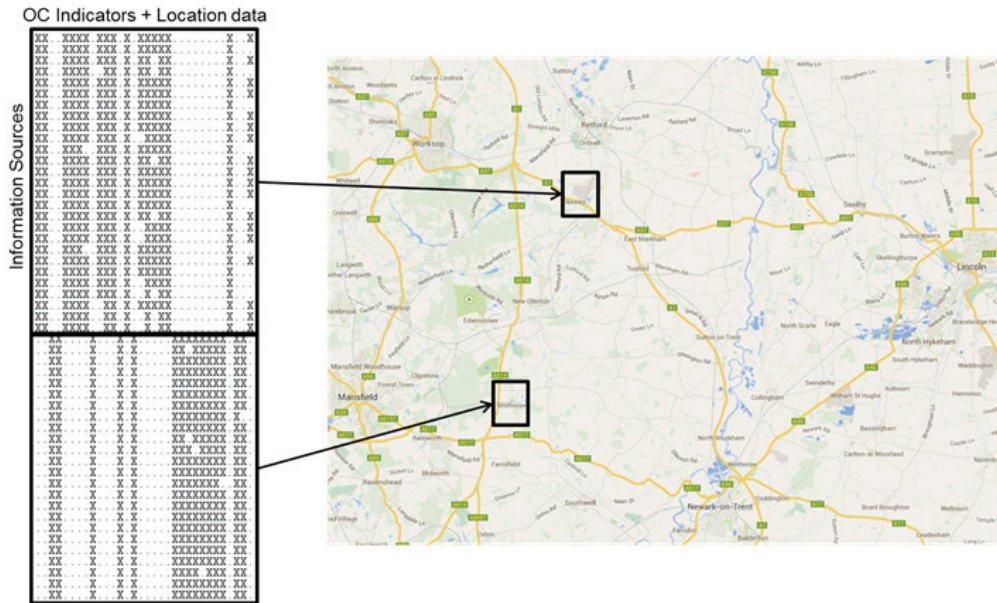
Figure 5. A concept lattice showing the association between drug trafficking and the use of violence (Andrews, Akhgar, Yates, Stedmon, & Hirsch, 2013)
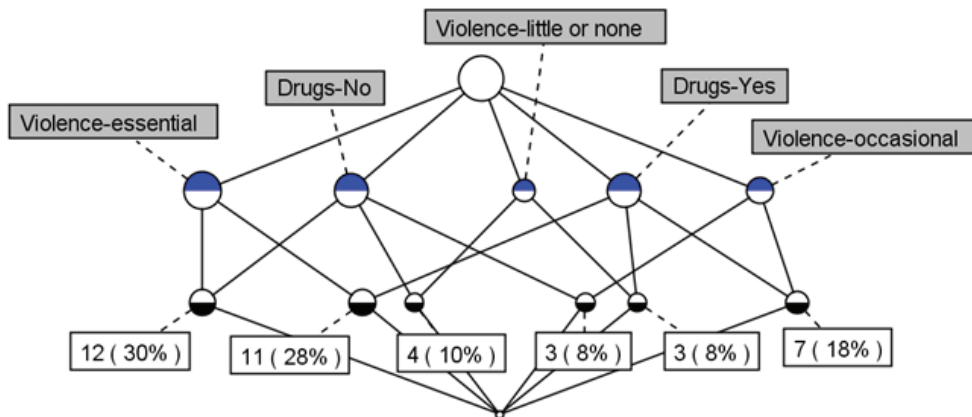
Essentially E-PEUMS describes the integration of existing LEA systems in EU Member States. Figure 6 illustrates some of the existing LEA systems in four example EU Member States (plus Turkey as an associated State) being integrated by E-PEUMS. Notably, E-PEUMS would be EMPRISES' implementation architecture based on the SOEC EA, associated data architecture, Transaction Concept, and CGE model. Figure **6** also shows, it would also take advantage of existing interoperability environments, particularly FIU.NET and SIENA promoted by the

Figure 6. E-PUEMS solution concept integrating five Member States
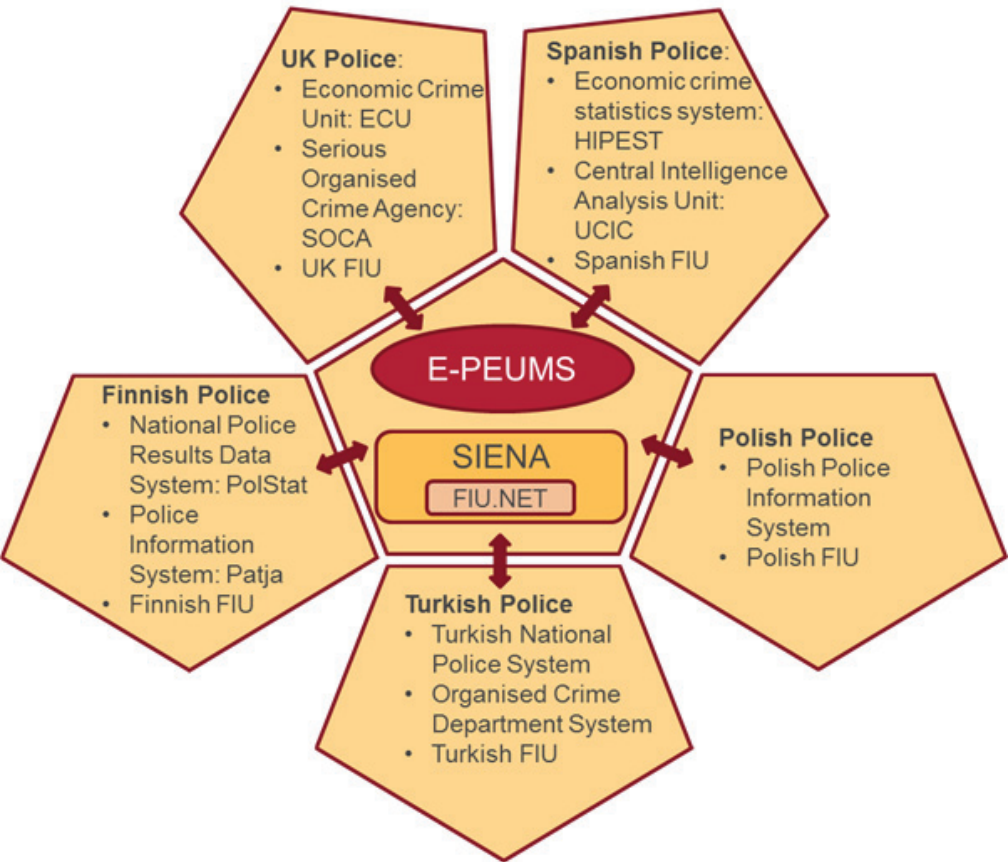
Europol the EU's law enforcement agency (Andrews, Polovina, Yates, Akhgar, & Bayerl, 2013; Andrews, et al., 2015).

THE E-PUEMS TOOL-KIT

Using the SOEC Architecture Framework described in Figure 1 earlier as its context and the discussion up to this point, EMPRISES would consist of a suite of new tools, technologies and techniques to provide new methods of monitoring, detection, evaluation and deterrence of SOEC, based on a shared inventory and taxonomy: the E-PUEMS Tool-kit Figure 7. Its functionalities may include the investigation of effective interventions in SOEC (to inform new guidelines and methods of combating and deterring such crimes), report of trends in SEOC, the identification of differences in EU/Country based legislation and tax law, identifying common modus operandi, situation assessment, economic evaluation of markets damaged, alerting of new organised investment fraud schemes, alerting for new threats of a particular SOEC and new trends, predictions of new types of crime by extrapolation of trends and new crime methods and visualizing the

Figure 7. The EMPRISES Toolkit
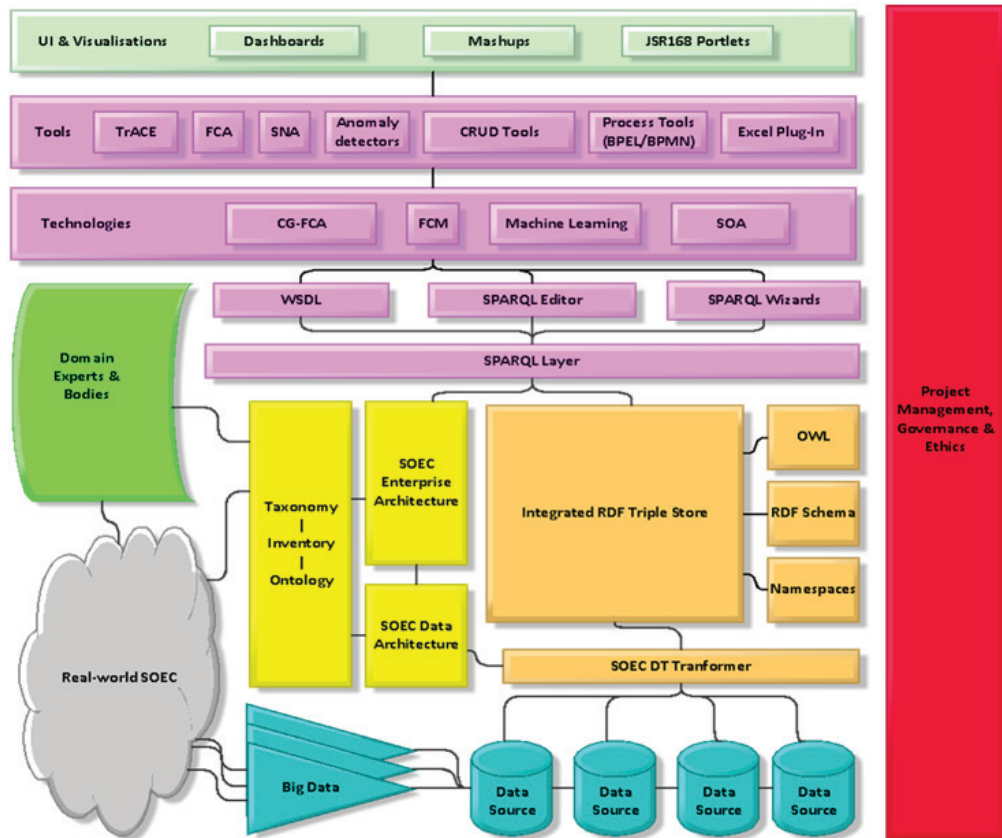
management structure of known groups and gangs, early warning of new SOEC by matching a SOEC's architecture components within and across the Member States.

Given that complex relationships, transactions, actions and events are difficult to represent in traditional RDBMS systems, EMPRISES would be supported by a RDF triple-store ontology (Meersman, Dillon, & Herrero, 2010). It would hold the SOEC inventory and taxonomy: the EMPRISES SOEC Knowledge Repository. Given the RDF approach, OWL (Web Ontology Language) and RDF Schema are also specified in the toolkit. Such semantic web technologies are better suited to expressing the relational complexity and conceptual, human-based nature of the problem domain through their knowledge-based architectures (Priss, Polovina, & Hill, 2007). As RDF can be represented in XML, XML conversions can take place as part of data transfer. An example is between RDF and UMF, the Universal Messaging Format. The RDF query language SPARQL, is the means to exploit the expressivity of an ontology, but normally requires expertise to write queries. To circumvent this problem, EMPRISES would include intuitive SPARQL Wizards and APIs for all of its SPARQL Endpoint tools, building on existing approaches used in other experiences such as CUBIST (CUBIST, 2012). For the economic evaluation of SOEC, EMPRISES could contribute to the WC3 SPARQL by creating a set of financial functions (macros) using the recently added SPARQL aggregation functions (Dau, 2012). EMPRISES would also exploit the popularity and ease of use of existing spreadsheet software,

such as Microsoft Excel, by building SPARQL Plug-ins for creating data visualisations such as charts, plots and graphs. There is an illustration of importing data into a Google spreadsheet using SPARQL (Uyi Idehen, 2015).

The tools might also include such components as fuzzy logic and probabilistic analysis (for predictive analysis, trends and situation assessment) (Kim & Bishu, 2006; PR-OWL, 2012), Conceptual Graphs for (Criminal) Transaction Modelling (identification of key agents, resources and facilitators for SOEC) (Jedrzejek, Falkowski, & Bak, 2009; Du, Song, & Munro, 2006; Mifflin, Boner, Godfrey, & Skokan, 2004), Formal Concept Analysis (FCA) for pattern finding (modus operandi and indicator analysis, threat detection, taxonomy visualisation, predictive analysis) (Snášel, Horák, & Abraham, 2008; Kirda, 2010; Thonnard, 2011), Social Network Analysis (SNA) (for the detection and analysis of OC groups and OC activity) (McNally & Alston, 2006; Fox, 2012; SAS, 2009), extending SNA with FCA: Formal Conceptual Network Analysis (to provide SNA with enhanced capabilities for analysis of OC group-group interaction and OC hierarchies, extending CGs with FCA: CG-FCA (identification of incomplete transactions, supply chains and transactional hierarchies, identification of missing agents in transitions) as described earlier (Andrews & Polovina, 2011), linked data analysis (for detecting financial pathways and supply and economic food chains) (Larreina, 2007), Fuzzy Cognitive Mapping (FCM) (for determining weighted cause-and-effect relations and actions) (Carvalho & Tomè, 1999) and Machine Learning (for diagnostic analysis of suspected SOEC activity and economic impact) (Schrodt, 1995).

The pan-European inventory of SOEC would be accessible and queried via a SPARQL-based Create/Retrieve/Update/Delete system. By using a simple, ontology-based visualisation of the SOEC repository, end-users would have a clear view of the underlying data structure and relationships therein. For inventory queries, new FCA-based visual analytics could make the most of the underlying SOEC ontology, allowing semantic, relational, hierarchical, recursive and propagating queries possible, beyond the current state of the art in traditional data base systems. An E-PUEMS dashboard would be created that provides a common, unified, interface to the tools in the tool-kit. In order to support pan-European response, its Service-Oriented Architecture (SOA) framework would be extended to incorporate the dashboard as a web-service front-end. This would create a pan-European service, greatly extending the opportunities for collaboration and cooperation in the monitoring, detection, evaluation and deterrence of SOEC. A TrACE (Transaction Analytics of Criminal Enterprises) component would also be developed that would focus on the transaction concept as described earlier, and co-exist with the tools described above to provide a complementary analytical view that is directly based on Transaction Concepts modeled in CGs and supported by FCA.

MULTILINGUAL SUPPORT

Given the diversity of languages involved, the importance of multilingual support is also pertinent. Such support would be provided through Internationalisation (I18N) given it is globally understood vehicle for the display of data and results of analysis (W3C, 2015). I18N allows any language to be plugged-in to an LEAs interface with no need to re-write any code. It is simple to switch between languages at run-time as web-services are delivered to different Member States with key words looked up dynamically by the taxonomy. The provision of multilingual capabilities for data extraction is more challenging but again is aided by the agreed taxonomy. Multilingual support would be developed based on Natural Language Processing (NLP) text and data parsing searching for taxonomy matches. Once key words are found, inferences can automatically be made between text words, for example, to identify data values using natural

Figure 8. EMPRISES Multilingual Support Process
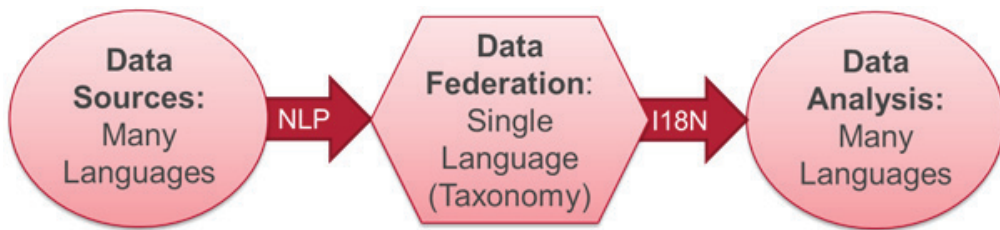
language semantics for each supported language and rules based on the EA ontology. This is a complex problem so would need to be added incrementally by EMPRISES by for example the five nationalities illustrated in Figure 6 referring to E-PEUMS earlier. Figure 8 outlines the process for multilingual support.

CONCLUSION

The EMPRISES framework adds value to national, SIENA and FIU.NET systems by increasing the effectiveness of communication across Europe through an agreed common language (taxonomy) of SOEC, including multi-lingual support. Global and EU businesses, governments and markets use sophisticated models, tools and techniques to detect trends and predict opportunities (and threats). These tried and tested approaches can be articulated through EA (Enterprise Architecture), the Transaction Concept, Conceptual Structures, E-PEUMS, and a toolkit that implements the resultant SOEC Architecture that enriches the taxonomy with that body of knowledge. The common platform could then be more easily integrated with other systems around the world e.g. in supporting the work of the International Criminal Police Organization (Interpol). EMPRISES thus provides the Member States' LEAs with better insight and understanding of the crimes and criminal groups that they are investigating and new means by which the illegitimate businesses of SOEC can be monitored and combatted.

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- Requirements engineering
- Security and trust
- Semantic enterprise architectures
- Standards and recommendations
- Transaction-oriented architectures
- E-science
- E-medicine
- Forensic computing
- Grid computing
- Natural language systems
- Robotics
- Semantic Web
- Pragmatic Web
- Topic maps
- Web 2.0
- Augmenting collective intelligence
- Business intelligence
- Discovering misuse and fraud
- E-learning, smart VLEs (Virtual Learning Environments)
- E-social science
- Folksonomies
- Government account-ability and e-democracy
- Intellectual property management
- Legal analysis
- Healthcare management
- Knowledge discovery
- Knowledge management
- Managing ambiguity, nonsense or contradictions
- Teaching and learning of logic
- Supporting social action
- Cultural, localization and internationalization
- Entertainment
- Linguistics
- Peirce's extential graphs logic
- Portal development
- Semiotics, signs and meaning making
- Supporting sensory disabilities, dyslexia or other differently abled
- Supporting alternative (e.g., lateral) thinking
- Thinking with diagrams
- User modeling
- User personalization
- Visual analytics

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