# INFORMATION MODEL TO SUPPORT SUSTAINABLE PROCUREMENT

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## ABSTRACT

Sustainable practices which increase awareness of people in industries which deal with environmental issues need to be implemented. However, information that needs to be considered to make informed decision on sustainable procurement is located in different places and comes in different form, either internal or external of the organizations. Thus, there is a strong need to consider this information to be interrelated and put in one place for easy access. The aim of this paper is to consider all of these concerns and develop information model to support sustainable procurement. It is hope that this information model is able to guide buyers in making the most informed decisions.

**Keywords:** *Sustainable Procurement, Information Model, Knowledge Management, Universities, Informed Decision Making*

## 1. INTRODUCTION

Public procurement of works, goods or services plays very important role in stimulating innovation and it represents 18% of EU GDP [1]. While it is important to ensure that public money is being spent in a right way so that people could gain long-term benefits, public organizations should think of the way to greening their procurement practices. Integrating sustainability into public procurement could benefits in so many ways, among them are minimising damage to the environment, reducing whole life cost and value for money [2]. According to [3], some countries have implemented several approaches to green their public procurement, including all 50 states in US. However, many countries are still formulating and developing their policies in this area.

Developing sustainable procurement is one element of a broader sustainable development effort. Brundtland's definition of sustainable development for the United Nations [4]:
'Sustainable development is development that meets the needs of the present without compromising the ability of future generations to

meet their own needs'. There are many definitions of sustainable procurement [5]. The Sustainable Procurement Task Force defines sustainable procurement as a
'*process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst minimising damage to the environment*' [6].

Sustainable procurement involves three different aspects: economic, environment and social. Below are the examples of some possible issues in each aspect in sustainability:

1. Economic : local sourcing, suppliers reliability, SMEs [7]
2. Environmental : carbon emission, waste disposal, energy efficiency [7]
3. Social: worker exploitation, bribery and corruption, minimum labour standard [8]

During the discussion with key people in

sustainability from UK universities, they tend to discuss their procurement practice in terms of economic and environment and not social aspect. It is believed that these two aspects are considered as a forefront of the sustainable procurement implementation in UK universities, as they received directions from DEFRA to produce carbon reduction plan.

In UK universities, economic and environment aspects are more easily incorporated into the practice of sustainable procurement compared to the social side [5]. For our research context, sustainable procurement will be mainly discussed in terms of environment and economic because the context for this thesis is procurement in universities. Some of the familiar terms related to sustainable procurement are 'whole life cost' and 'value for money'. 'Whole life cost' is closely related to environment aspect while 'value for money' is always referring to economic aspect.

The concept of value for money means that to purchase any products, one should not only depend on the minimum purchase price but the cost over the product's whole life cycle [9]. This concept could be incorporated into sustainable procurement [9] by giving a certain percentage as a weighting to sustainability credentials during a tender process [5]. A lifecycle approach requires the purchasers to consider all the costs incurred from the buying cost to the maintenance and disposal costs [10].

In the next sections, we will be discussing on research background, methodology used for this research, procurement process modelling and information model. Other than that, we will also be looking at the process of creating information model and how social network analysis (SNA) is used for procurement network. Finally, we discuss about research contribution before the work is concluded.

## 2.    RESEARCH BACKGORUND

Sustainable practices which increase awareness of people in the industries which deal with environmental issues need to be implemented [11]. Many organizations nowadays have realized the importance of integrating the traditional supply chains with sustainability practices as the resource availability decreases while the world population increases [12]. To address this matter, the concept of sustainable or green supply chains has been introduced. Through this concept, sustainability is integrated with supply chains to ensure that any harmful impacts by supply chains on the environment are reduced.

Public procurement is one of the main functions in a government [13] and acquires goods and services for public sector organizations [14]. According to [15], public sector bodies wishing to acquire goods or services tend to award contracts to framework suppliers if possible. Effectively managed procurement is essential to provide necessary goods and services that provide value for money for taxpayers [16].

Since the government has the ultimate control over public sector, all of the public organizations are under greater or lesser pressure to follow government policies. In UK, the public sector procurement is governed by the UK law and legislation which is in turn shaped by EU directives, as the UK is an EU member state. EU directives for sustainable development are discussed below to examine how they impact on governments in EU including the UK in particular.

## 3. METHODOLOGY

Universities were chosen as a particular example of the broader category of public sector organizations in the UK, to identify problems that they experienced with procurement and how they attempted to solve those problems. This helped to gain an understanding of the information infrastructures used to support current procurement processes in UK universities, as well as providing general understanding of the procurement processes. Interviews were the main method of collecting this data.

Social Network Analysis (SNA) was used to produce diagrams of the networks among the key stakeholders in order to understand the pathways of their communication. SNA helped identify the relative importance of individual roles in the procurement network.

Data analysis software NVivo was used to transcribe interviews transcript. Based on that, information architecture framework to support sustainable procurement was designed.

In this research, we use a mixed of case study method to explore the current practice of procurement in universities as a starting point before we examine their transformation plan from procurement to sustainable procurement. Exploratory case study will be used in the beginning to explore the current procurement practice in universities, then explanatory is used to describe the cause and effect of the implementation of procurement strategic plan. Exploratory case study is suitable for a research that has small number of literature [17]. As mentioned by [5] and [17] in their paper, limited research was carried out to study sustainable procurement in public sector,

especially in university. [17] looks at local authorities and this is a broader sector. He used structured interviews for data collection while [5] used focus groups and in-depth interviews in UK and Australia.

Our case research was restricted to public universities in UK. Universities were an interesting and convenient example of organisations that practice public procurement in UK. There did not appear to be significant published research on how sustainable procurement decisions were actually made in university sector as opposed to how they should be made. This research was focused on the types of information being used in university procurement and on assessing the steps being taken towards sustainable procurement and its impact on the information needs. As explained earlier, this research started with exploration following the nature of this research is to understand the action taken to implement sustainable procurement, hence the choice of exploratory case study was well suited to answer the research questions [17]. For this research, we have approached 5 UK universities and a purchasing consortia on top of University of Brighton.

### 2.1 Contextual Information

Besides interview data, documents related to sustainable procurement, such as sustainable procurement policy documents and university buyers' guides were also collected. It is in the interests of organizations concerned with best practice and governance to make these documents were accessible via the internet using search engines. Government documents such as EU and UK Legislation, the HEFCE carbon reduction initiative and sustainable procurement guides from DEFRA are examples of the sources used. The use of multiple sources of data helps us understand the interview data. It also extends the information network by identifying new (institutional) stakeholders. These documents were then copied into Nvivo 10 to be coded along with interview data.

Interview data and documents that has been transferred to NVivo software will then be analyse to identify the types of information needed to choose sustainable IT products.

### 2.2 Content Analysis

Content analysis has been defined as *"..a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns"* [18]. According to [19] , the process of content analysis begins from the early stage of data collection. It was important to make sure that the data collected met the objectives of the study when being coded [20]. Qualitative content analysis involved a series of systematic procedures to ensure valid and reliable inferences for data processing [19].

As noted above, interview data were transcribed verbatim to make sure all information was recorded. To analyse these transcripts, software known as Nvivo 10 was used. This type of analysis needs a coding scheme to be developed. In this case, for example, to identify the types of information needed to choose sustainable IT products, relevant words needed to be coded and words with similar meaning or close relationships grouped together. For example, two statements below could be coded as "Power Consumption" and be placed in "Product Criteria" category.

Another example was to find the sources of information and types of information. So, relevant data will be highlighted and categorised in relevant category. In this case, these information were categorized as "Sources of Information" – Product, Manufacturer, Suppliers, Buying consortia, accreditation bodies, university etc. From these information, we will find the types of information that can be derived from each group. For example, type of information that can be derived from Product are Product Manufacturer, Product Specification and Product Model.

### 2.3 Social Network Analysis

At the beginning of this research, it seemed likely that enhancing procurement decision making to take account of sustainability was essentially a matter of appropriate knowledge management. We found some researchers who argued that identifying and analysing the pattern of communications within the knowledge management processes in an organisation could be facilitated by social network analysis (SNA) (e.g. [21]. However, the communications that took place between organisations were as important as those that occurred within organisations, in this research context. A disadvantage of formal organisational charts in organisations is that they do not show knowledge flows. However, SNA could help to map more accurate networks of the knowledge flow [22]. The initial intention was to use SNA as a means of assessing collaborations between the key stakeholders that could support the development of 'green' supply chains. However, an approach based on gathering detailed data from all stakeholder organisations in an entire supply chain seemed over-ambitious, so we took a strategic approach to our scope to focus on the interface between a single organisation and its suppliers, that is, the

organisational procurement process. Social network analysis (SNA) was used as a tool to identify and understand the communication pathways among the key stakeholders involved in the organisation and to map the communication between them [23], [24].

Apart from all the benefits of SNA, we did not use its numeric techniques but considered SNA as a tool from its qualitative perspective where it

was used to identify the key stakeholders for the procurement network.

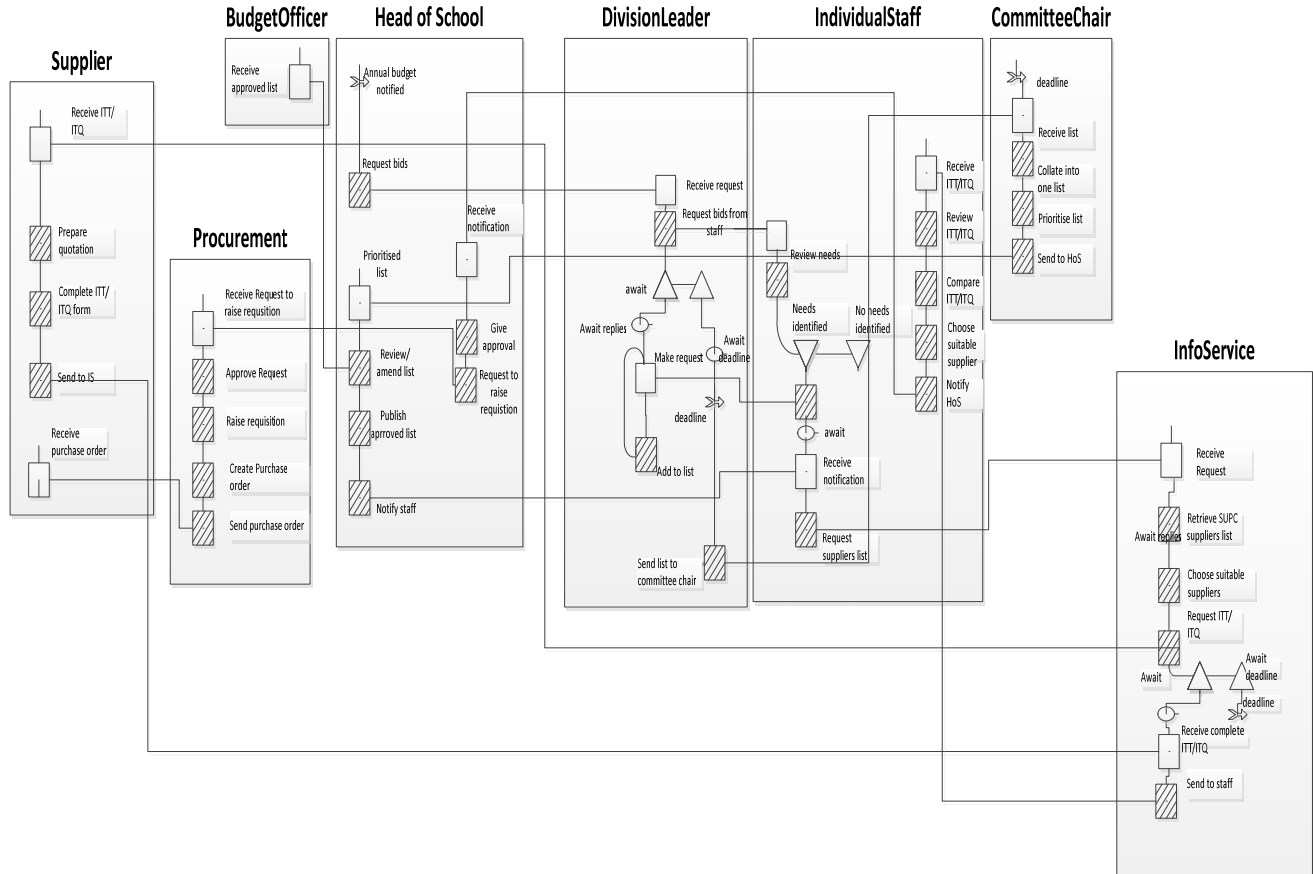While it is interesting to discuss the benefits of SNA, we still need to be aware of its limitations.



*Figure 1: Procurement Process Model*

## 4. PROCUREMENT PROCESS MODELLING

Procurement process modelling as shown in Figure 1  demonstrates the procurement processes in University of Brighton (UoB). The procurement process in UoB is centralised but with a devolved budget strategy whereby university departments pay for items that are purchased on their behalf.

Thus the purchasing process, particularly at its earlier stages, might differ in its detail depending on the school. The descriptions here reflect the practice in the School of Computing, Engineering and Mathematics (CEM).

In the case of CEM, the School comprised three Divisions. A School resources group was chaired, in rotation, by a Division Leader. The focus of this group is planning how to spend their yearly capital budget. In the Computing school, there were representatives of each Division who collected lists of what staff wanted to buy (e.g: PCs). Once representatives had completed their lists, the committee considered them. If the total cost of purchase requests exceeded the budget, the committee prioritized them. The Head of School then approved how the money would be spent based on the group recommendations. The quote from the interview is as follows:

*"…Our representative collected together of the list of what computing wants..47 pieces or half the dozen mice of what it has be..and he then goes to the committee, they argue, discuss because normally staff want more than this budget..they prioritize things..ultimately the Head of School decides how he is going to spend the money based on the recommendations of the groups.."*

The formal process of IT procurement in UoB was triggered when an approved requisition was received by procurement department from the School or other university department. The process was now coordinated through E-Fin, an electronic ordering system. A budgetary authorized officer in the department recorded the Head of School's authorization of a requisition (that is a purchase request) through the E-Fin. Once authorized, it was passed, in the case of IT products, to Information Services so that they could raise a purchase order from the requisition before being passed to the suppliers. Suppliers were chosen from those covered by the Framework Agreement. If there were no suitable suppliers listed in the framework agreement for the item needed, the Information Services officer needed to look for new suppliers. Then, the purchase request will be passed to procurement department to raise E-Fin requisition. Information Services was a central place where all the products were received from the suppliers. The products were then delivered to the end users. Finally, an invoice was sent by the supplier and finance officer will deal with the cross-charging.

## 5. INFORMATION MODEL

A key objective of this research was the identification   of the additional information that
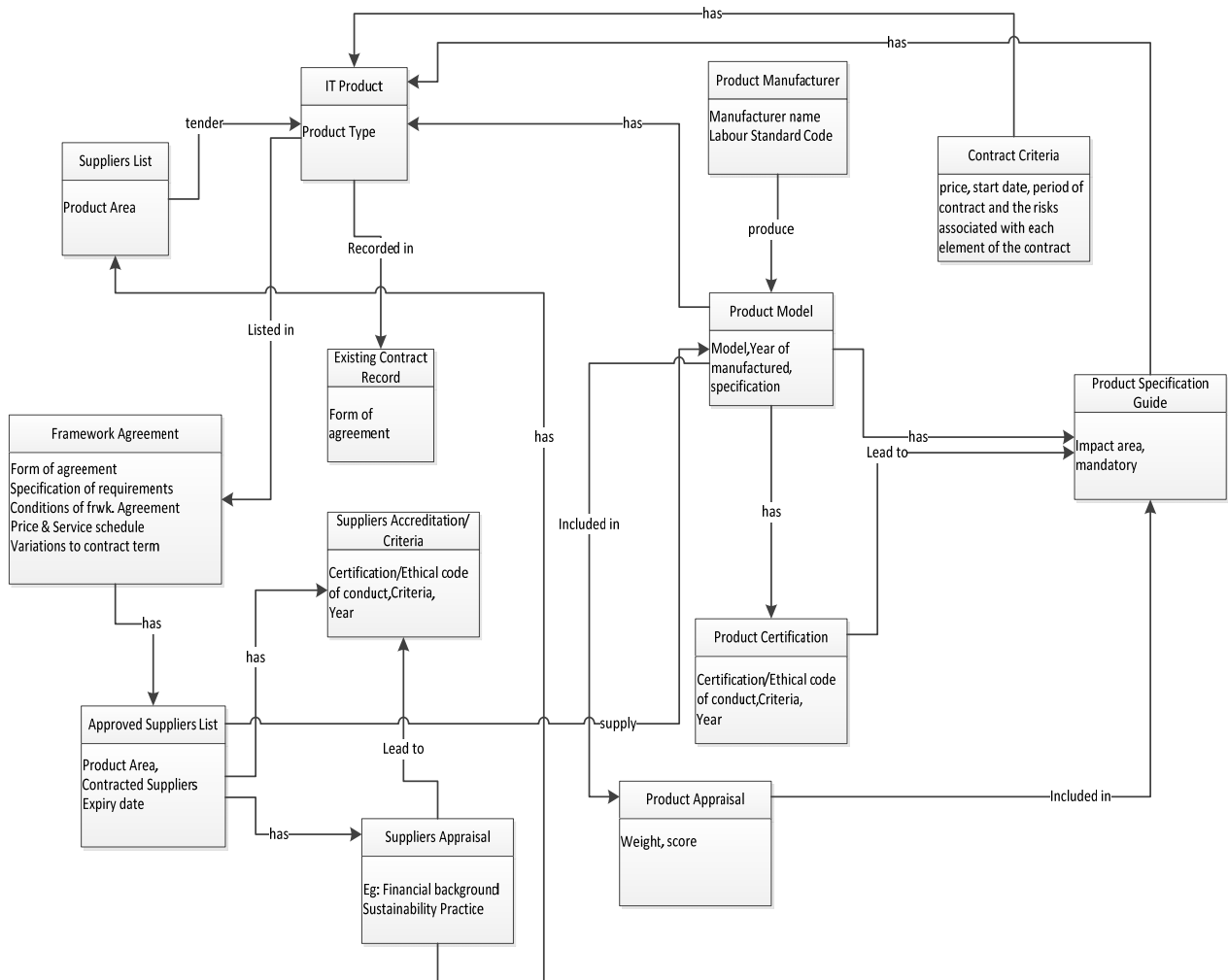


*Figure 2:  Information Model*

procurement staff would need in order to make effective sustainable product selection decisions.

This would be based on recognised best practice documented in procurement literature and the practical insights of procurement practitioners as captured through interviews. Information model was then developed to assist decision makers to come out with the most informed decision of sustainable product. As shown in Figure 2, various information sources were link together to support sustainable procurement in order to make informed purchase decisions.

## 6. PROCESS OF CREATING AN INFORMATION MODEL DIAGRAM / FRAMEWORK

To create an information model diagram, there are some processes that need to be done. Data were gathered from the interviews and documents (policy, guidelines etc) to find what data are needed to facilitate decision makers in making informed decisions. We highlighted all the important information needed by all the stakeholders to make purchase decision using marker pen in NVivo software, e.g. suppliers background, product model, sustainability criteria etc. Some of the elements in the information model were mentioned in the literature review and best practice.

After we have gone through all the available data sources, it can be concluded that there are 13 types of information that needed to be considered when making sustainable procurement decisions, hence to be used to create an information model. Procurement information model was developed to represent information architecture of sustainable procurement. In the information model, the relationships that link the information are very important because it could be used to navigate through the model to identify the types of information needed to carry out certain processes. For example, to find laptop suppliers accreditation from approved suppliers' list, buyer can navigate from IT Product > Framework Agreement > Approved suppliers' list > Suppliers' Accreditation. Referring to Figure 2, there are 13 types of information that are interconnected to each other in the model. Most of the information would be internet sources, or criteria will be one of the requirement to bid for tenders. Buyers can also review suppliers *contract criteria* made with SUPC. Sometimes, buyers will ask the suppliers for their sustainability credentials before purchasing any equipment. SUPC supports CIPS sustainability index [25] and NETpositive

Sustainability Management Tool to be used by the suppliers to demonstrate their sustainability credentials and initiatives to the buyers. However, *Supplier list* element in Information model is not covered by framework agreement. It is for the buyer who would like to make purchase outside the contract, where they require some equipment that is not covered by SUPC suppliers. *Existing contract record* is such as documents or policy that are needed to make procurement decisions. These documents or information come from many different external sources, such as international organisations, buying consortia, accreditation bodies, product manufacturers and suppliers and many more. They need to be integrated into a network of information that could facilitate procurement decisions.

*IT product* in Information model refers to the type of IT equipment one wants to purchase. According to GBS criteria, Office IT equipment has nine product areas to choose: computer monitor, desktop computers, inkjet multifunctional devices, printers, laptop computers, laser multi-functional devices, laser printers, scanners and workstations. For example , if there is a request to buy a laptop, then IT product is a laptop. These list of equipment is covered by *framework agreement* e.g SUPC framework agreement. In framework agreement, there will be lists of suppliers that has been approved by SUPC to supply products according to their product area (*Approved Suppliers List*). To become SUPC approved suppliers, one need to fulfil the suppliers criteria required by SUPC (*Suppliers Appraisal*). Once the suppliers awarded tender by SUPC, they will become SUPC suppliers for 4 years before the contract ended. *Suppliers Accreditation* referred to contracts that was made in the past. In framework agreement, each product area will show the suppliers company or *product manufacturer*. This is important for the buyer to refer to the *product model* that are produced. Product model will show the specification of the equipment. This allowed the buyer to check on any certification that is granted for any specific equipment (*Product Certification*). SUPC is using *product specification guide* eg: GBS product criteria to choose products that meet their requirements (*Product Appraisal*).

## 7. SOCIAL NETWORK ANALYSIS FOR PROCUREMET NETWORK

During the initial stage of this research, the procurement network was explored in order to understand the pathways of communication. During this exploratory study, we explored the relationships of UoB procurement process with

other parties. We would like to see with whom procurement staff interacts within their procurement process. A 'Snowballing' technique was used to identify the actors in the network, where interviewees were asked to suggest further interviewees. Initially, we planned to use quantitative SNA techniques to identify the network of people involved in university procurement processes. However, after conducting initial content analysis on the data that we have collected, it is found that the networks that we were looking into were not homogeneous, that is that actors were not all of the same type. Most SNA techniques analyse networks assume the nodes within the network and the means of communication are all similar in nature. Instead, the networks found procurement tended to be heterogeneous where the actors were a mix of people, computer systems and organisations, SNA techniques work best where actors are uniform, with similar characteristics and attributes [26].

It was also found that the types of relationships were also varied in the procurement network. For example, some relationships involved the transfer of information while some relationships exist to 'use' the other party's policy or procurement framework. Once again, the variety of relationships in this network does not fulfil SNA requirements that type of relationship must be the same for all actors. However, SNA diagrams themselves were useful in helping understand how the actors in a network were interconnected. We did not use other functions of SNA such as measuring the 'between-ness' or centrality of the nodes or actors. SNA diagrams were generated using UCINet software.

Figure 3 represents the connections among people in university procurement process. This actor network diagram was generated based on the interview data in UoB. At this stage of the research, we explored as many connections as possible relating to the procurement and tried to understand the connections and whether
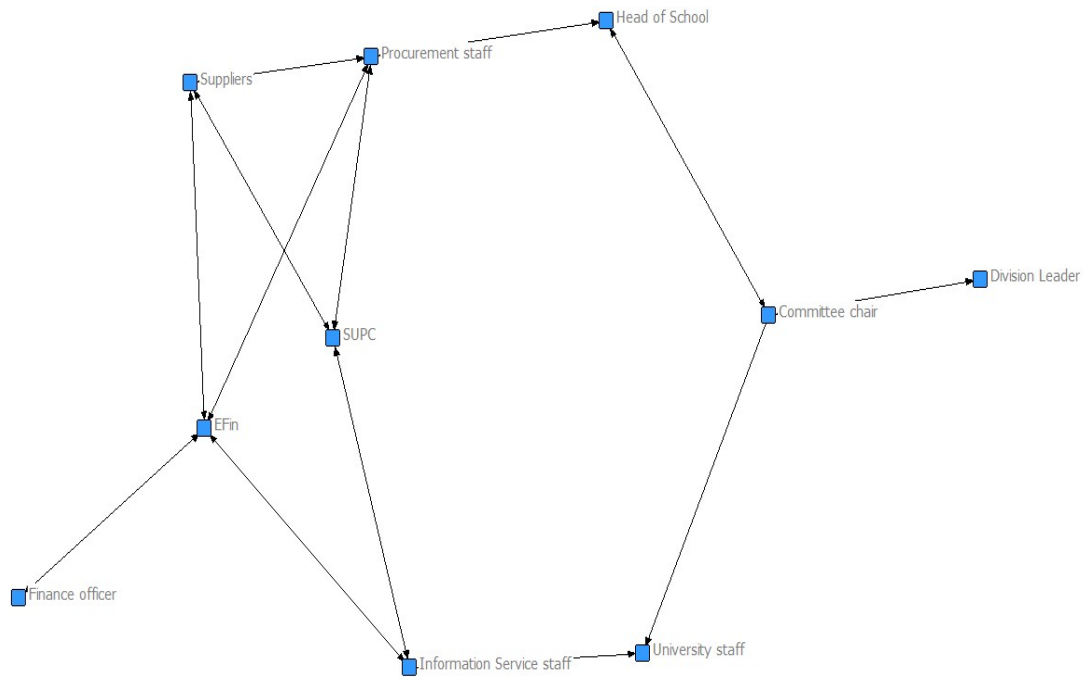


*Figure 3 :  SNA for  Procurement Network*

the connections were useful to our research or not. For example, the connection of university central procurement staff and SUPC would be different from the connection between university central procurement staff and a School or other department. The type of connection that we were looking for involved the transfer of information or

knowledge needed to make informed procurement decisions, such as product criteria, green suppliers, etc.

Actors tended to have specific roles. They could come from different backgrounds and from different organisations. For example, Budget holder is a university staff at any department while

Southern Universities Purchasing Consortium (SUPC) is a separate organisation that works closely with the university in procurement.

Table 1 below will explain each role in SNA diagram above. There are 10 actors that play different roles within the university. Actors come from different background, either internally or externally of the university.

*Table 1: Role of each actor in SNA diagram*

| Actor | Role |
|---|---|
| Procurement Services | Procurement services department in university responsible for the university's procurement policy. |
| Head of School | A member staff in any school or department who can authorise purchase requests relating to the part of budget for which they are responsible. |
| Division Leader | The person who chaired the CEM School Resources Group meeting which prioritised the CEM yearly capital budget. (One of the three Division Heads in the School, who takes the role in rotation). Other Schools may have different arrangements. |
| Committee chair | Plan yearly capital budget of School in university (CEM): other Schools may have different arrangements |
| UoB staff | A staff member in any school or department who has made a request to buy something. |
| Information services (IS) | The assessment of any IT equipment to purchase is delegated to this department. |
| eFin | E-procurement system that is used as an interface between the university (buyer) and suppliers. |
| Finance officer | Head of the central university finance function. |
| Suppliers | External parties who supply goods or services. |
| Southern | Act as an intermediary |

| | |
|---|---|
| Universities Purchasing Consortium (SUPC) | between IS and the supplier in terms of negotiating framework agreements. |

Having explained the role of each actor, we will now look at the types of relationship that they have with each other. Table 2 shows the relationship type among actors. The SNA diagram confirms the lack of a uniform type of relationship among actors. The focus here is on the actor(s) involved in this procurement network for each type of relationship.

*Table 2: Types of relationships between actors in SNA diagram*

| Actor 1 | Actor 2 | Type of relationship |
|---|---|---|
| Procurement Services | eFin | Procurement staff raise requisition on eFin system |
| | Suppliers | Send invitation to tender |
| Head of School | Procurement Services | Request to purchase |
| Division Leader | Committee Chair | Yearly school budget planning |
| Committee Chair | Head of School | Send prioritised list of purchase needs to budget holder |
| Committee Chair | Division Leader | Contributes to list of purchase needs with purchase requests from Buying staff |
| UoB staff | Committee chair | Send purchase request |
| Information services | UoB staff | The people with the technical expertise to advise on best buy |
| | eFin | Send authorised requisition |
| eFin | Suppliers | Send purchase order |
| Finance officer | eFin | Authorise requisition |
| Suppliers | eFin | Receive |

| | | purchase order |
|---|---|---|
| | Procurement Services | Submit tender form/response to any request from procurement |

From the constructed actor network diagram above, it seems that it has contributed to a clear understanding of the communication flow of the UoB procurement process. Even though other techniques can be used, such as the data flow diagram, it could be argued that not all relationships can be adequately portrayed in terms of formal data flows. Traditional techniques normally use attributes of people such as age, gender, occupation, etc. to define social structure compared to SNA that views the ties or relationship between two or more people, organisations or institutions as an essential units of analysis [27]. For example, the Head of School might have many informal discussions with various people who are in agreement with the School purchases list. In terms of the research context, this diagram could help in identifying the relevant information that flows between actors based on the types of relationship listed in Table 2, for example, the link/relationship between IS and buyers that discuss on the best buy.

## 8. THIS RESEARCH AND PRIOR WORK

It has come to our knowledge that no prior work has developed information model based on the most relevant information to consider the most informed decision making to support sustainable procurement. Thus, this research is pioneer in identifying the most relevant information that need to be considered by procurement staff in making sustainable procurement decision.

## 9. CONCLUSION

As a conclusion, sustainable procurement requires specific information to enable buyers made the right decisions. Thus, this research contributes in providing information model that consider information resources located either internal or external of the organization,  to guide procurement staff to make the most informed decision making. For future research recommendation, it is hoped that the information model could be validated to align to university's procurement strategic planning.

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