

Public eProcurement adoption

Economic and political rationality

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Public eProcurement adoption: Economic and political rationality

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Abstract

eProcurement is on the political agenda throughout Europe. Denmark is among the forerunners with respect to establishing a public procurement portal. So far, the overall success of the public eProcurement portal has been limited. In this paper, we discuss possible explanations for the limited success. Our focus is on whether or not the underlying mechanisms and rationalities supporting electronic marketplaces in private business are present in the public sector. The paper suggests that efficiency explanations of electronic marketplaces should be considered alongside with specific political-structural elements that characterize the public sector.

1. Introduction

At present eGovernment is on the agenda both in research and practice and several initiatives related to eGovernment have already taken place. Some of the reported initiatives have focused on optimizing administrative tasks related to the interaction with citizens through electronic means e.g. on-line public service delivery in general [14] and eHealthcare [27]. With respect to these aspects of eGovernment different degrees of interaction and the requirements for degrees of integration have been addressed [21]. Other initiatives have focused on providing new electronic routines to political processes, such as voting [12]. Common to the above-mentioned initiatives is the focus on the relationship between government and citizens. In sum, the production of public services rather than considerations related to the allocation of resources in the public sector [18] have been the target for the initiatives. Given the fact that it is a general belief that eGovernment solutions must serve

everybody regardless of IT-capabilities, social or economic resources, governmental initiatives face several challenges. These challenges go beyond mere rationalization of routines and efficiency with respect to electronic interaction with citizens.

It has been emphasized that an important part of eGovernment is to focus on the delivery of faster and cheaper services and information to citizens, business partners, employees, other agencies, and government entities [21]. The importance of this approach to eGovernment is not questioned in this paper. Instead focus is shifted towards the organizational management in the public sector, which focuses on how the public sector manages its internal operations [4].

Our focus is on an aspect related to eGovernment, which has so far received little research attention: eProcurement. That is the public sectors' potential improvement of operations through electronic means in the form of electronic purchase of goods and services. "An effective public procurement policy is fundamental to the success of the single market in achieving its objectives: to generate sustainable, long-term growth and create jobs, to foster the development." This quote is taken from a Green Paper on public procurement issued by the European Union in 1996 [11]. At the time the Internet was still in its infancy [15] and was not an obvious mean for optimizing public procurement processes unlike today. At the Lisbon summit in 2000 it was decided that EU should pay special attention to eProcurement. It was emphasized that "The emergence of the new Information and Communication Technologies (ICTs) offer promising opportunities as regards the efficiency, transparency and opening-up of public procurement" [10]. However, European governments appear to have hesitated adopting the concept of eProcurement. One reason could be the burst of the dot.com bubble in the spring of 2000 and the concomitant reluctance to

establish the underlying structures of electronic marketplaces. Another and maybe more likely explanation could be rooted in structural conditions in the public sector.

The underlying argumentation in favor of eProcurement in the public sector is driven by a number of considerations. In our opinion, there are three main reasons why the public sector is a natural place to start with the electronic procurement of goods and services.

First, because of the general interest in taking the lead with respect to the diffusion of e-commerce at a national level [5]. It has been argued that the introduction of public eProcurement methods can have a tremendous impact on the development of e-commerce in Europe [26] especially since the electronic public procurement process represents a huge incentive for building national electronic marketplaces.

Secondly, due to the nature of products being purchased by institutions in the public sector. Standardized products generally characterize public procurement. It is generally believed that electronic marketplaces are more suitable for standardized products [22]. This assertion is supported by transaction cost theory, which argues that low asset specificity requires less contractual arrangements owing to lower risk of sunk costs [6], which according to the theory leads to a shift from hierarchies to markets [22].

Thirdly, given the public sectors' expenditure on the purchasing process alternative methods of procurement should be considered. A recent policy statement by the Danish government [24] argues that the incentive for eProcurement adoption is to free resources from purchase tasks which then can be used for improved services to the citizens. Using an analogy from the business environment similar ideas with respect to rationalization and freeing of resources for improved customer service through IS adoption have been pursued for decades [13].

The aforementioned justifications for eProcurement are mirrored in the following strategy statement of the Danish public procurement portal. "With a public sector procurement of goods and services for approx. DKK 100 billion per year, even modest improvements in efficiency will be of great value for the Danish society. By virtue of the public sector's purchasing volume, increased use of e-commerce will furthermore contribute to the penetration of e-commerce in Denmark in general. The suppliers will get accustomed to e-commerce and an infrastructure will be established." [2].

In recognition of the general pursuit of the diffusion of e-commerce in Denmark [5] and the great potential

for savings in the public sector, a Danish Public eProcurement Portal (PePP) was established in 2002. The objective of this paper is to present the PePP and to analyze whether or not the rationalities for joining an electronic marketplace/ a public procurement portal exist in the Danish public sector. The research approach applied in the paper is mainly based on a literature review of the underlying concepts supporting eProcurement. Additionally, public information regarding the procurement portal, combined with personal insights from one of the key policymakers is used to describe the content of the PePP.

The remainder of the paper is organized as follows. The following section presents the concept of public procurement. Additionally, types of goods, which can be purchased via eProcurement by the public sector institutions, are outlined. The next section gives an overview of the public sector in Denmark. The objective of the section is to provide an insight into the scope of the public sector in Denmark and at the same time to outline the technological capability of this area of government. Technological capabilities are considered to be of major importance if an eProcurement strategy is to be implemented successfully. Thereafter the PePP is presented. The following section presents the concept of electronic marketplaces, which is the underlying e-business model for a public procurement portal. This leads to the penultimate section, which discusses and analyzes the likelihood of adoption and diffusion of the portal. Finally, a conclusion and perspectives for the research on the Danish public sector with respect to eProcurement is outlined.

2. The concept of public procurement

Most purchases in public sector institutions require a bureaucratic procedure to be followed. The majority of items are bought on requisition. This means that enormous amounts of efforts are spent on sending forms back and forth in the system. The internal coordination costs are therefore high with respect to the contracting procedure for commodities. As pointed out by Berryman et al. [8] it is generally assumed that the procurement of commodities represent the greatest potential for savings with respect to electronic purchases especially due to the reduction in work procedures, which can be automated. This is the case both with respect to the ordering process and the handling of invoices and payments. This combined with the regulated tendering process makes the idea of automating procurement an attractive option compared with the status quo. Unlike private procurement, public procurement is highly regulated. For Denmark most of

the regulation is based on European Union law. In the EU it is illegal to favor domestic over foreign firms. For purchases exceeding EUR 160,000 and 248,000 for state institution contracts and county/municipality contracts respectively (cf. Directive 93/36 of June 14th, 1993) a publicly advertised tender in the Supplement to the Official Journal of the European Communities is mandatory.

In a report prepared by KPMG Consulting for the Ministry of Science, Technology and Innovation [24] different groups of commodities have been identified as being suitable for eProcurement in Danish public institutions:

Table 1. List of commodities suitable for eProcurement

State institutions	Counties	Municipalities
Travel and hotels	Medicine	Office supplies
Office supplies	Hospital supplies	Provisions
Books	Office supplies	Books
Office equipment		Material for education
IT		Ironmongery
Furniture		Fuel
Provisions		

All these products are characterized by the fact that they are easy to catalogue and thereby also possible to make available via electronic channels. Additionally, experience has shown that most of the product categories are already represented on-line. One of the most cited examples of on-line products is books (e.g. Amazon.com) but sellers of office supplies (e.g. officedepot.com), travel and hotels (e.g. amadeus.net) and IT (e.g. dell.com) have also demonstrated that these products can be sold via electronic means.

This suggests that the technical problems with respect to presenting the goods and services online are more or less solved. It should be noted that the above-mentioned examples are included to illustrate the suitability of the products for eProcurement rather than realistic options for public sector institutions in Denmark.

One aspect, which should be kept in mind with respect to procurement in the public sector, is the significance of public purchase policy. Guidelines for purchasing are to a larger extent used in the public sector than in the private sector. The public sector in Denmark has for example recently shifted their focus from cost efficiency in their purchase processes towards more qualitative measures. Ecology (green procurement) is for example an issue, which has been prioritized high in the public purchase policy.

3. The public sector in Denmark

In this section we will present the overall features of the public sector in Denmark. Attention is focused on the elements related to the actual size of the public sector both with respect to size of the workforce and the national annual budget and expenditures. Data is presented to give an insight into the potential savings provided by adopting eProcurement. In order to illustrate the structures of the public sector some information is provided on how the public sector is organized in Denmark with respect to division of central and regional tasks taken care of in counties and municipalities. A third element which is found to be of relevance when describing the public sector in Denmark is the level of IT usage at present. The IT maturity of organizations has generally been found to be of major importance for adoption and implementation of e-business including eProcurement [20].

3.1. Size of the public sector in Denmark and possible range of eProcurement

In 2000 Denmark's population totaled 5.4 million [29]. In rough figures from 2001 the size of the total workforce in Denmark was 2.5 million people. Of these about 900,000 people were employed in the public sector [29]. This means that more than one third of the workforce is employed in the public sector. In 2001 the total expenditure was 337 billion DKK in the national annual budget. When considering the possible impact of implementing a procurement portal it should be remembered that a relatively small amount of the public expenditure is set aside for procurement. In the above-mentioned report by KPMG Consulting it was estimated that approximately 90 billion DKK were used for public procurement [24]. The analysis of state purchases has shown that commodities with a value of approx. DKK 8 billion is suited for e-commerce [2]. The direct effects of public procurement should therefore be seen in a broader perspective including possible reduction in man-hours spent on the procurement process and indirect benefits derived from restructuring of work routines.

3.2. The structure of the public sector in Denmark

Compared to other countries in the EU, Danish counties and municipalities have relatively more independent competencies [17]. Minimum standards are generally outlined at state level but in order to cater for regional standards – even in a relatively small country – there is a political consensus, which accepts regional differences. This is a balancing act between

homogeneity and the qualitative benefits gained by the populations' regional preferences (ibid.). The extensive decentralization of public sector tasks and responsibilities, which has taken place during the last ten years, must generally be expected to lead to a reluctance to subscribe to the idea of centralized purchases via electronic marketplaces [5].

3.3. The use of IT in the public sector in Denmark

In general there is a high degree of familiarity with IT usage in the public sector. In the most recent statistics from the National Statistical Bureau covering year 2000 [28] it is reported that 87 percent of all public institutions offer on-line forms and services to their clients. About 45 percent of the institutions receive information from citizens and companies by electronic means – typically via the Internet. This indicates that the public sector is willing to use electronic means for communication and at the same time that it knows how to use the Internet as a media for performing transactions.

Furthermore, the report provides information about how the public sector has benefited from the digitalization of work processes. Depending on whether the institution is at state, county, or municipality level about 65, 85, and 60 percent respectively have experienced some degree of change and rationalization of work routines due to IT implementation. Regarding the perceived benefits derived from IT implementation the state, county, and municipality institutions report that they have each experienced a freeing up of resources at about 40, 65, and 30 percent respectively. In this context it is not to be discussed how to interpret the above mentioned figures. Regardless of interpretation the statistics seems to indicate that there is a positive attitude towards IT usage and the perceived benefits derived from IT implementation, which is important if successful implementation is to be carried out, see for example [19].

Based on the various secondary data presented here it is our assessment that the public sector in Denmark holds the necessary IT maturity and positive attitude towards technology, which is a prerequisite for the adoption of eProcurement. However, the potential savings caused by eProcurement adoption should be seen in a broader perspective. One issue, which might be crucial for adoption and diffusion, is the decentralization/ centralization issue, which is so central especially for institutions at municipality level.

4. The Public eProcurement Portal (PePP)

The development and implementation of electronic commerce business models, such as a procurement portal, in organizations is a challenge, which goes beyond mere technological functionality [20]. Top management support, organizational adaptation, and training of employees are examples of issues, which are critical for implementation success of any organizational information system. For the implementation of eProcurement in the public sector an extra set of considerations have been suggested to have impact. These include financial risk, risks of building the portal and legislative issues [26]. Oliveira and Amorim suggest that three types of models can be considered in order to meet the specific demands related to implementation of public eProcurement: 1) The public model, here all tasks are run by government including the investment and risks of building the portal. 2) The private model, here all tasks are run by private entities, which bear the investment risks of the project. 3) The mixed model (public-private partnership). In this model the participants share investment risks and the benefits of the project. To present how the above-mentioned issues have been met in practice by the consortia behind the public eProcurement portal in Denmark a few facts about the portal are presented below. The model, which the Danish public sector has chosen for their eProcurement is based on the public-private partnership model. Financial risk is placed on a private party, the gatetrade.net portal [1], which is in charge of operation and management of the portal. The public sector on the other hand developed the system in collaboration with the players behind the portal and the public sector pays for using the portal [2].

To gain a deeper understanding of PePP it is useful to take a closer look at the players behind gatetrade.net. gatetrade.net is founded by four of the largest businesses in Denmark:

- TDC, which is the largest telecommunications company. Until recently TDC had monopoly on telecommunication in Denmark.
- Danske Bank, which is one of the two largest Danish banks.
- Maersk Data, which is part of the Maersk industry group that includes international shipping and transportation (Maersk Sealand), air transport (Maersk Air), and mining of oil and gas.
- Post Denmark, which operates the national mail service. Post Denmark has recently been converted to a public limited company.

Apart from representing substantial financial resources due to the involvement of these four large businesses gatetrade.net also carries out a great number of business activities. When gatetrade.net was launched in 2001 it was introduced as a neutral third party marketplace. The four founders agreed upon placing all their procurement on the electronic marketplace in order to secure the necessary critical mass both with respect to demand and supply. This has solved one of the classic problems of who to embark a marketplace first – buyers or suppliers [6]. So far the economic success of gatetrade.net has been limited. One of the initial problems gatetrade.net faced was the limited number of willing suppliers. However, this is not surprising given the general weakening in e-business during the launch of the marketplace. The strategy pursued by the consortia behind the PePP was to select a marketplace where there was a high potential for business transactions from day one. This objective was to a large extent fulfilled given that PePP involved itself in an already ongoing electronic marketplace.

5. Efficiency enhancement through PePP

When it comes to procurement, public institutions are to a great extent driven by similar cost pressures as private businesses with respect to efficiency of operations and work-processes [3]. Services of public institutions, which in Denmark include hospitals, nursery schools, and eldercare institutions are similar to private businesses, managed by means of efficiency and budgetary control. For decades IS research has recognized that one of the advantages of adoption of information systems in organizations is rationalization and reduction in administrative workload, thereby reducing in costs of administration (see for example [9,25]). With the emergence of electronic commerce in its present form in the mid 1990s this theme has had a renaissance under the labels of electronic marketplaces [7,8] and eProcurement [31].

The concept of eProcurement has been defined as “electronic tendering and procurement of goods and services” [31]. The benefits derived from eProcurement (be it employed by private business or public institutions) include according to Timmers a wider choice of suppliers, lower cost, better quality, improved delivery, and reduced cost of procurement. In particular we argue that eProcurement enhances efficiency through two main avenues: (a) transaction cost savings and (b) direct procurement costs savings as indicated in Figure 1 below.

If eProcurement is carried out in an electronic marketplace as illustrated in the lower part of Figure 1 previously separate procurement functions on the state, county and municipality level can be bundled and shifted to an electronic platform. This will lead to direct procurement cost savings in terms of human resources and administrative overhead in all three levels of public administration. Examples of procurement activities shifted to the electronic marketplace include bidding, ordering and payment related data processing that can be electronically supported for standardized goods. A positive side effect is also increased transparency and accountability as electronically conducted processes can be more easily monitored and benchmarked across organizational units.

In addition, because an electronic marketplace consists of an interorganizational information system, this transaction platform allows the participating buyers and sellers to exchange information about prices and product offerings quickly and cost efficient [6]. A transaction forum is created where there is a potential for bringing together a huge number of buyers and sellers, and where the cost of conducting trade is marginal compared to a traditional brick and mortar marketplace [16]. This creates a huge potential for transaction cost saving in terms of reduced search, matching, and order control costs. Both cost effects (direct procurement and transaction costs), over time, will increase with the wider adoption of PePP among private businesses and the public sector.

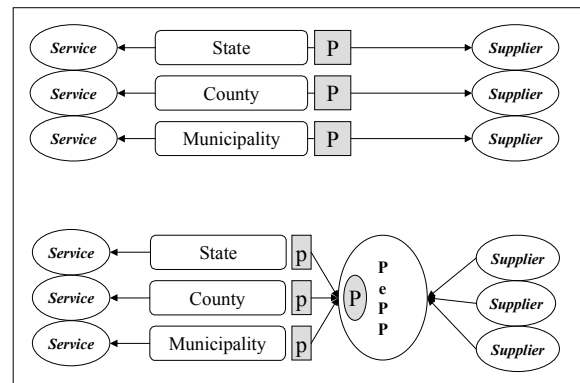


Fig 1: Efficiency gains through PePP

Malone et al. [22] have among others, elaborated on the connection between transaction cost theory and information technology leading to electronic marketplaces. Building on their work, we suggest that their argument may apply equally well to the shifting of procurement functions from hierarchical public procurement to IT enabled procurement through

privately organized markets. For example, Malone et al. argue that technological progress within information systems had established an electronic interconnection, thereby making electronic markets, more attractive relative to hierarchical means of doing business.

The benefits of electronic markets should be most favorable when both asset specificity and the complexity of product descriptions are low. This is because both can lead to market failure. If goods purchased are highly standardized and accordingly there is little reason for market failure to exist, e-markets are in general particularly well-suited for conducting related procurement transaction. Even in the case of standardized goods, however, there is a possibility of asset specificity to occur. In essence, asset specificity refers to small-number bargaining situation that results in dependency, which can be opportunistically exploited. For example, a purchasing department in a municipality has developed good relations to a particular supplier -- e.g. it has developed human asset specificity surrounding the purchase of a standardized good. Through such complementary investments a large-number bargaining situation transforms into a small-number bargaining situation with accompanying opportunistic potential. If this is the case, moving the procurement transaction in an automated form to an electronic transaction platform can reverse small-number bargaining situation and reduce associated transaction risks.

Moreover, Malone et al. [22] suggest that buyers and sellers could reap substantial benefits from the electronic interconnections if three effects are present: 1) the electronic communication effect, which is facilitated by the technologies that reduce both the time and cost of communicating information; 2) the electronic brokerage effect, where many different buyers and sellers are connected through a central database; and 3) the electronic integration effect, where the information technology is used to reuse data in different business processes [30]. Malone et al. [22] suggest further that if these three forces would lead to a relative stronger decrease in the unit cost of coordination in markets, one would expect a shifting of activities organized through hierarchies towards a market-based organization of the activities in question.

In the case of the public sector in Denmark an argument in favor of adoption of market based eProcurement can be made. The electronic interconnection is established in the public sector in Denmark, cf. Section 3. PePP eases also the number of alternative suppliers that can be considered, improves matching, and decrease the costs of the entire product selection process. By implication all three effects may potentially be available for standardized public procurement through electronic market transaction.

However, in addition, potential efficiency gains of introducing a market-based solution may, to large extent, be due to the reduction of direct procurement costs. This is, through shifting procurement activities from several decentralized layers of public hierarchies toward a transparent central market place for procurement. Whether, associated efficiency gains – both in reduced direct procurement costs and transaction costs - can be realized depends, in part, on whether potential adaptors are willing to sacrifice political independence for an increase in overall public procurement efficiency. The next section, discusses, possible impediments to adoption of efficiency enhancing PePP in Denmark.

6. Economic and political rationality

The potential scope of eProcurement for the public sector was, as mentioned in Section 3.1, estimated to be DKK 8 billion. By December 2002, about one year after the launch of PePP, the value of public procurement transactions on the portal was 0.01 billion [2]. This is puzzling when taking into consideration that there is,

- a wide range of goods identified to be suitable for eProcurement among different types of institutions in the public sector in Denmark (cf. Section 2),
- a large potential for reduction of man hours when taking into consideration that 900,000 persons are employed in the public sector in Denmark (cf. Section 3.1)
- a relatively high IT maturity in the public sector in Denmark (cf. Section 3.3), and
- a strong market structure given that PePP is a supplement to gatetrade.net, which has a large pool of suppliers.

This data naturally gives rise to speculations about the cause of resistance towards adoption of the PePP, despite large potential efficiency gains. A way forward in analyzing this issue is to recognize that 'public administration (despite similar cost pressures) operates in a different world of control'.¹ Accordingly, political rationality of local actors merits attention alongside economic rationality, which figured eminently in the last section. We will argue that actual adoption patterns deviate from predictions expected in an economic rationality argument. Politicalization of decentralized procurement practices in the Danish public administration helps explaining such deviations.

The public sector in Denmark already uses modern telecommunication technologies for transferring data, both internally in the institutions but also in its

¹ *As one of our reviewers rightfully points out.*

interaction with citizens. The public sector institutions perceive the electronic interaction to be beneficial with respect to reduction in work-load and rationalization, cf. Section 3.3. The cost of coordination must therefore be expected to hold the potential of further cost reduction for the public sector if the eProcurement portal is adopted. This leads to the assumption that the electronic communication effect will affect adopters of PePP positively.

Likewise, given the fact that the public sector has used the strategy of connecting to an already existing marketplace with a critical mass of suppliers this could support the electronic brokerage effect. As outlined by Malone et al. [22] the fundamental idea of the electronic brokerage effect is that the database can match buyers and sellers and thereby reduce the need for contacting a large number of sellers in the purchase process. However, a potential obstacle for gaining the full benefit of the electronic brokerage effect is the highly regulated tendering process, which the public institutions in EU countries are subject to. The underlying database structure for PePP has to be very advanced in order to manage the highly regulated tendering processes. Given that a breach of the tendering procedures can lead to severe penalty it is plausible to expect that public institutions will continue to allocate resources for controlling that they comply with the rules for tendering. *Based on these considerations it is questionable whether arguments on efficiency gains override political arguments in favor of hierarchical control of regulated procurement.*

The electronic integration effect is one of the concepts of e-commerce, which has been discussed extensively especially with respect to EDI [23]. The argument given by Massetti and Zmud is that electronic integration is multi-dimensional. However, even if electronic integration in its most simple form is to be fulfilled this requires reuse of data throughout the organization. Leading to the net result that time is saved and errors can be avoided because data is only entered once. Gatetrade.net and PePP offer integration with respect to purchase order, order confirmation, bill of carriage, and invoice. However, the limited number of types of messages, which are exchanged electronically, reduces the potential for full integration of data throughout the organization. In addition, a critical issue with respect to electronic integration across several layers of public administration is the local standard and IT assets used. The standard necessary for electronic integration of PePP on gatetrade.net is XML (eXtended Markup Language). *It can therefore be argued that the electronic integration effect, while technological feasible, remains not realized as decentralized actors in public administration incur locally the costs of system*

transition in terms of training, process change and IT expenditures, while efficiency gains depend in size on the numbers of simultaneous adopters by several public agencies acting autonomously. Based on these observations it can be argued that the *economic rationality* regarding PePP adoption is *limited by political rationality* of dispersed actors in public institutions acting according to local political interest and rationality.

Another type of explanation might play an even more important role is related to the political structures of the public sector in Denmark. One thing, which characterizes the public sector in Denmark, is widespread decentralization. During the 1990s the responsibility for individual institutions was decentralized. One crucial issue is therefore whether the economically independent institutions are interested in subscribing to a system, which in principle centralizes purchase processes and facilitates monitoring and state control. *By implication, even if there were common shared understanding of economic benefits of PePP, centralized procurement practices conflict sharply with the balance of power between public agencies and norms of de-central public governance.*

A hybrid model of centralization/ decentralization, might provide a feasible solution in the implementation of eProcurement. Thus, we suggest a split between responsibility and task. The managerial and economic responsibility of the individual institutions should be kept decentralized whereas tasks related to the purchase function should be centralized in a public procurement portal for efficiency reasons. The pursuit of this model would provide the best outcome of two principles: 1) the institutions would maintain self-governance with respect to decisions related to when and what to purchase, and 2) the institutions would benefit from the advantages of the central public procurement portal with respect to where and how to purchase. Thereby, the public sector institutions could reach a position of reaping the advantages of automatization in electronic market purchases, including pooling of public demand. Whatever procurement solution will be adopted, it cannot neglect either economic or political rationality.

7. Conclusion and directions for further research

eProcurement is on the political agenda throughout Europe. Denmark is among the forerunners with respect to establishing a public procurement portal. The strategy for establishing the portal was driven by a partnership between the private and the public sector.

In practice the public sector has chosen to have their portal as a supplement to a private driven electronic marketplace. The electronic infrastructure is established but widespread activity on the portal is absent. Out of an estimated potential of DKK 8 billion of eProcurement per year only DKK 0.01 billion was exchanged through the eProcurement portal in year 2002.

Our analysis suggests that even though the economic rationalities behind adoption of electronic marketplaces and eProcurement are present this is not enough for adoption of PePP among the public sector institutions in Denmark. Structural-political issues related to the widespread decentralization, which has taken place in the public sector during the last ten years, create a serious barrier for a centralized procurement process through eProcurement. One way out of this dilemma is to split responsibility and tasks. Our suggestion is that the managerial and economic responsibility of the individual institutions may be kept decentralized whereas tasks related to the purchase function should be centralized in a public procurement portal.

This preliminary presentation of the PePP highlights a number of fruitful research themes. In our future research focus will be on differences of perceived economic benefits across levels of public administration, and in particular how this perception is influenced by local political contexts. As far as theory development is concerned the current paper urges further inquiry into the relation between economic rationality (which assumes a single unified actor operating in political vacuum) and political rationality (which at times overrides economic rationales), as well as the relative impact of both on the adoption of PePP.

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