



STATE OF E-BUSINESS IN THE BULGARIAN CONSTRUCTION INDUSTRY Report for CIB TG83 СЪСТОЯНИЕ НА ЕЛЕКТРОННИЯ БИЗНЕС В БЪЛГАРСКАТА СТРОИТЕЛНА ИНДУСТРИЯ Доклад за CIB TG83

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International Council
for Research and Innovation
in Building and Construction



STATE OF E-BUSINESS IN THE BULGARIAN CONSTRUCTION INDUSTRY

Report for CIB TG83

СЪСТОЯНИЕ НА ЕЛЕКТРОННИЯ БИЗНЕС В БЪЛГАРСКАТА СТРОИТЕЛНА ИНДУСТРИЯ

Доклад за CIB TG83

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Medal of the University of Douai, France, Bulgarian Academy of Sciences Award “Prof. M.Drinov”, Medal “Kolio Fitcheto”, and Honorary Member and Gold Medal of the BSTU. He has had a distinguished career with over 400 peer-reviewed publications and has recently published in material and sustainability. He has been a full member of the Bulgarian Academy of Sciences since 1993 and was elected corresponding member in 1995.

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International Council for Building (CIB) Task Group TG83: e-business in Construction

The TG83 is an international collaboration forum established to generate a programme of actions directed at identifying best practice and promoting e-business in construction. It was established in March 2011 with the objectives of conducting joint research with interested parties; to appraise and promote the use of web-based technologies for collaboration and e-business in construction; and to provide a forum for discussion, debate and evaluation of technologies, research and concepts in the area. TG83 defines e-business as the use of Information Technologies in business processes. This often leads to process innovation with the use of enabling technologies such as the internet, CAD, BIM, cloud-based technologies, GIS among others. This survey and the report have been produced as a key output of TG83 in association with the Bulgarian Construction Chamber.



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1.0 Background

The Bulgarian Construction industry was considered as part of a developing economy which has gradually strengthened since 2016 when it exited the recession which commenced in the late 2000's. Having suffered from 2011 to 2015, with negative growth of -1.95%, it retained growth in 2016 and is forecast to improve to produce a 2.10% growth rate for construction over the forecast period of 2016 to 2020 (Green, 2016). Green (2016) further suggests that this will increase the value of the industry from US\$9.8 billion in 2015 to US\$10.9 billion in 2020 due to investments in road, rail and transport infrastructure. It is no surprise, therefore, that the majority of the respondents to this report come from the civil and infrastructure engineering sectors. Despite 5% of the total Bulgarian workforce being employed in construction and a further 20% in other civil engineering activities such as mining, water supply and waste management (NSI, 2016), little work has been carried out to determine the current level of Information and communication Technology (ICT) / e-Business penetration within the sector.

The use of ICT is often directly linked with innovation in the Construction industry (Redwood et al, 2017). E-Business is a subset of ICT and was defined initially by IBM (Gerstner, 2002) in a very broad manner as the process of transforming key business processes through internet use. This broad definition was expanded by Li (2007) to comprise every facet of exploitation of ICT as a means of producing effectiveness and efficiency through innovation and technology use. These efficiencies are examined by this report, with a focus on the construction industry and the processes it uses. Whilst significant progress has been reported in other disciplines through innovation to transform physical processes into electronic forms, its penetration into the construction industry has not been widely examined. The potential for e-Business generated workflows to utilise ICT innovations and therefore enable leaner work flows has been well documented (Cordella and Tempini, 2015; Ashworth & Perera, 2015). In addition, ICT has increased communication providing instant messaging, via the medium of internet solutions, Building Information Modelling (BIM), cloud based applications, and other ICT systems (Alwan et al, 2015). Furthermore, the increased transparency and improved communication that intelligent 3D BIM and the linked common data environment brings is seen as one of the greatest drivers for BIM adoption (Eadie et al, 2013).

According to Fulford and Standing (2014), e-Business is the main deliverer of efficiency improvements within industry, as it provides the automation of the workflows and the integration of each of the process components. The contract administration process within construction can be improved through all elements of the construction cycle: from preliminary design, through full design, specification, costing and cost planning, through the tender process, to construction, programming, monitoring (including change control through variations), to the final account and feedback through Key Performance Indicators (KPI's). In certain countries, Bédard, (2006) suggests the *"AEC Industry (Architecture, Engineering and Construction) are now routinely using computing and ICT Tools in many Tasks"*. Despite the professed benefits, many countries have not examined e-Business implementation and Bulgaria was one that has not examined the issue by gathering empirical data.

In 2011, a working group called TG83 was established to fill this gap in knowledge by the International Council for Research and Innovation in Building and Construction (CIB). This international working group had a global remit to stimulate and lead joint research into e-Business, and promote developments in web-based software for collaboration and e-Business in construction. This report follows similar reports into e-Business use in the United Kingdom (UK) (Eadie and Perera, 2016), Canada (Bowmaster et al, 2016), Ghana (Adzroe and Ingirige, 2016) and Australia (Gajendran and



Perera, 2016). A report on Sri Lanka is due to follow. Outputs from this working group include a textbook “Advances in Construction ICT and E-Business” for educational use (Perera et al, 2017). This report seeks to fill this knowledge gap in relation to Bulgaria through conducting an on-line survey of e-Business implementation and projected future trends.

2.0 Purpose of the study

The purpose of the study is to measure the rate of ICT adoption within the Bulgarian construction industry. It will examine core business documentation that can be produced and circulated electronically within construction, for a wide range of services such as distribution of materials identified by Papazoglou (2001), accounting, finance, marketing and project management identified by Issa et al (2003), human resource management and facilities management identified by Ashworth and Perera (2015), and the e-readiness of procurement in construction through the introduction of the NEC conditions of contract (Eadie et al, 2012). Electronic dissemination methods and document sharing had been identified as being facilitated through the internet (Li, 2006), Sky Drives / Cloud computing (Kumar and Cheng, 2010) and extranets (Martin, 2003). The significance of e-Business sharing methods and e-Business enabling technologies such as CAD, internet based programmes, BIM and Cloud computing had not been previously examined for Bulgaria. Furthermore, little preceding examination of investment in ICT systems, skills development in their use, the production of policy documentation within construction organisations and how these organisations wanted to support e-Business capacity within their organisations, existed. By examining these issues it seeks to fill these knowledge gaps by identifying new developments and trends in Bulgaria for e-Business in construction.

3.0 The Questionnaire Survey

The electronic questionnaire was the same for each country investigated. For Bulgaria however, it was translated into Bulgarian. Dissemination took place using the Limesurvey™ software which allowed those responding to the questionnaire to choose between answering in English or Bulgarian. Those seeking to complete the questionnaire could toggle between the languages to gain greater clarity for the questions if required and choose which language they wanted the questions to appear in. All respondents chose to view and respond to the questions in Bulgarian.

The study is divided under six main headings. These main headings in the survey are titled: Background Information; e-Business in Respondent Organisations; IT Investment Advice and e-Skills Development; Drivers, Impact and Barriers of e-Business; Improvement of e-Business and Future of e-Business. The software uses a web-based user interface to gather data into a MySQL database for analysis purposes. The survey was issued to construction organisations in Bulgaria, through the Bulgarian Construction Chamber database, with organisations clicking a link in the invitation email to register interest and then complete the survey. Analysis of these responses within the questionnaire results in an overall generalised view of e-Business activity and expected level of future ICT expenditure within the Bulgarian construction industry.

3.1 Overall Method

The questionnaire used scaled questions. The scale used was High, Medium, Low and none. A ranking was determined based on coding the results and using the relative importance index (RII) formula. The coding used: “High” coded 3, “Medium” 2, “Low” 1 and “none” 0.

The standard RII formula was then used to establish the respondent’s ranking on each of the questions which related to a ranking.

RII is defined by the following formulae:-

$$Relative\ Importance\ Index(RII) = \frac{\sum W}{A \times N} \quad (0 \leq index \leq 1) \quad (Equation\ 1)$$

Where:

W is the weighting given to each element by the respondents. This will be between 0 and 3, where 0 is the least significant impact and 3 is the most significant impact;

A is the highest weight (3 in our case); and

N is the total number of respondents.

3.2 Survey Method and Composition

The aforementioned e-mail was sent to every construction organisation registered on the Bulgarian Construction Chamber database. This provided details of the rationale for the survey and provided a link so that as many of the 2000 registered organisations would be able to complete the survey. Ninety-one organisations registered interest by signing up to complete the survey but only 55 submitted fully completed responses. The analysis was only carried out on the 55 fully completed responses, with a further 9 partially completed responses being ignored. Isaac and Michael (1998) published tables indicating the numbers to be sampled to provide a maximum of a 10% error level for validity of results from a total population. From this table, it can be determined that, as the Bulgarian Construction Chamber has 2000 organisations registered, a sample of 95 is required. Rubbie and Babbie (2009) then suggest that a minimum of a 50% response rate is required from the 95 to allow validity of the findings. With the abovementioned 55 completed questionnaires returned, this study exceeds the 48 required to equal the Rubin and Babbie (2009) criteria, and as a result the findings can be generalised as providing the viewpoint of construction organisations across Bulgaria.

3.2.1 Respondent Profile

Figure 1 below indicates the organisation type profile.

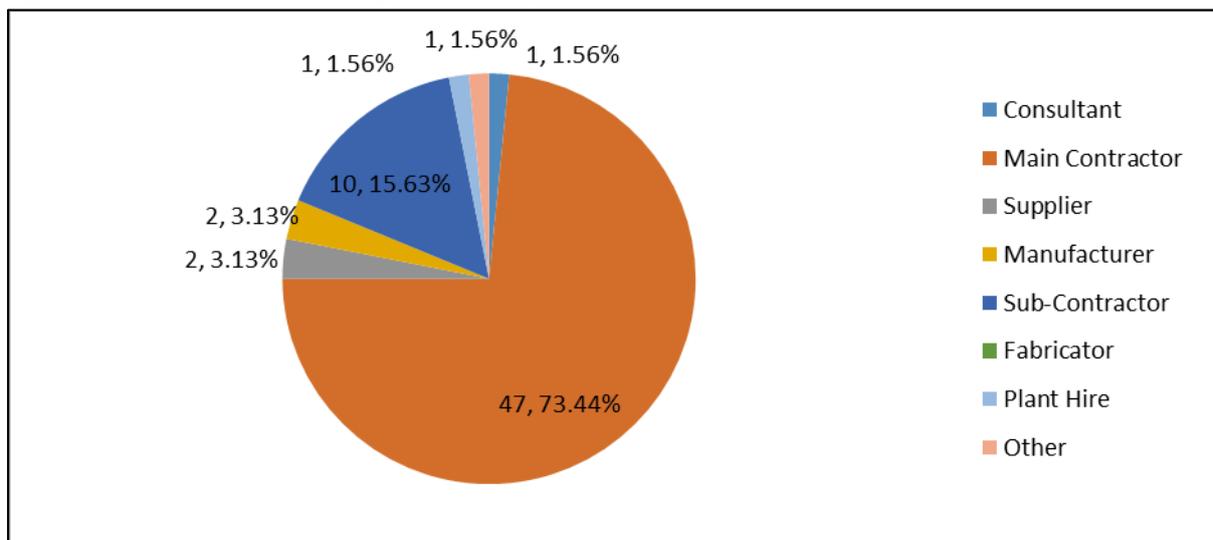


Figure 1 Survey Response Composition based on Organisation Type

Figure 1 indicates that the majority of respondents were from contracting organisations. Contracting organisations in the main carry out both design and build functions in Bulgaria. Organisations were

asked to choose all the roles their organisation carried out. The statistics in Figure 1 show all the combination of these roles. As design and build is the favoured route few choose consultant only as this role is built into the construction price. An example of multiple roles is a contractor having a sub-contractor role on other jobs. In another case one organisation was both a main contractor and a supplier. One organisation chose the other option and clarified this by using the term - Trading Company. Figure 1 indicates that 89.08% of respondents were contractors or sub-contractors.

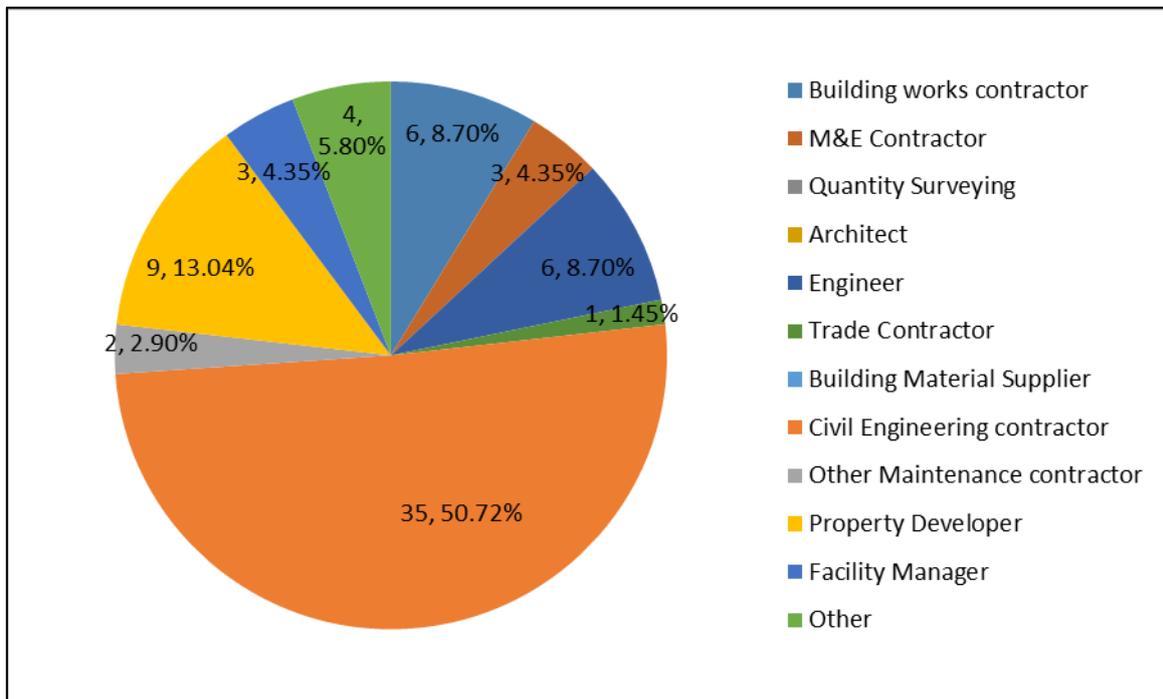


Figure 2 Classification of respondents based on work specialisation

Figure 2 provides the work specialisation of respondents. This shows the majority of respondents are from a civil or building contractor speciality (59.41%). This fits in with the NSI (2016) data and equates to the official breakdown of the specialisms. Four organisations chose their speciality as “other”, the descriptions indicated that these were working in Landscaping, quality management, water provision for irrigation and as a constructor of communication infrastructure.

Figure 3 again correlates well with the NSI (2016) and Green (2016) breakdown of the Bulgarian construction industry described in the introduction. It can be seen from Figure 3 that the majority of organisations are involved with Civil Engineering work (61.43%) supporting the claim that most investment has been in infrastructure projects. Building work is 10% roughly a sixth of the size which equates well to the employment statistics for each sector. The two who chose other were involved with electrical construction and landscaping.

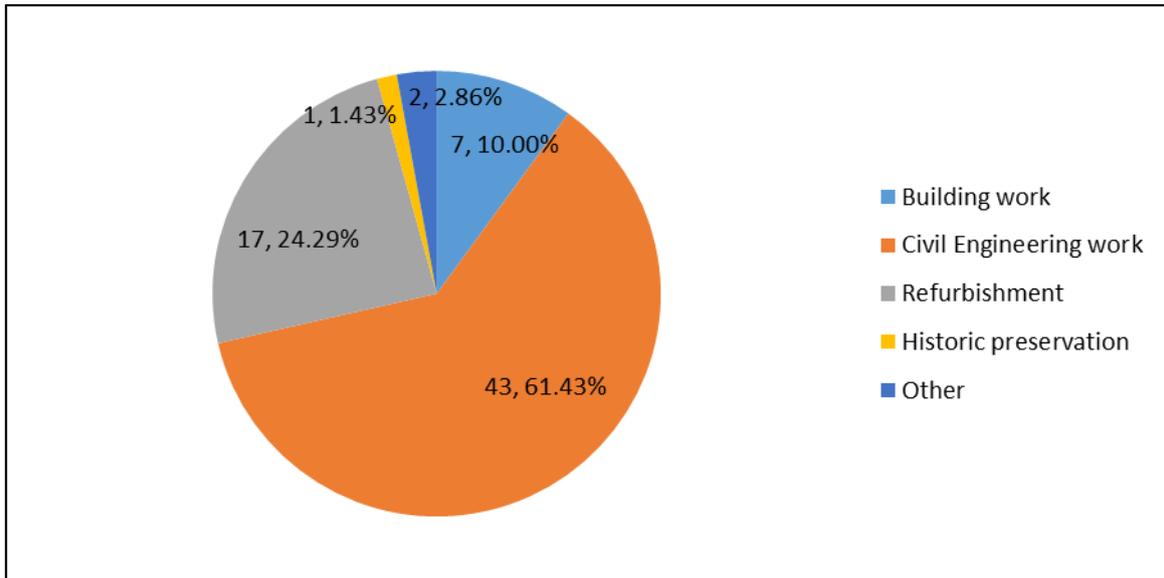


Figure 3 Classification of respondents based on area of work

Figure 4 indicates that 87% of those who responded were at the senior management level within the organisation, with an additional 4% middle management. The 9% who designated themselves support staff mainly worked as a dedicated IT specialist within the organisation. This indicates that the policy setters within the organisations were the ones which were responding to the survey and could accurately reflect the organisations practice in this regard.

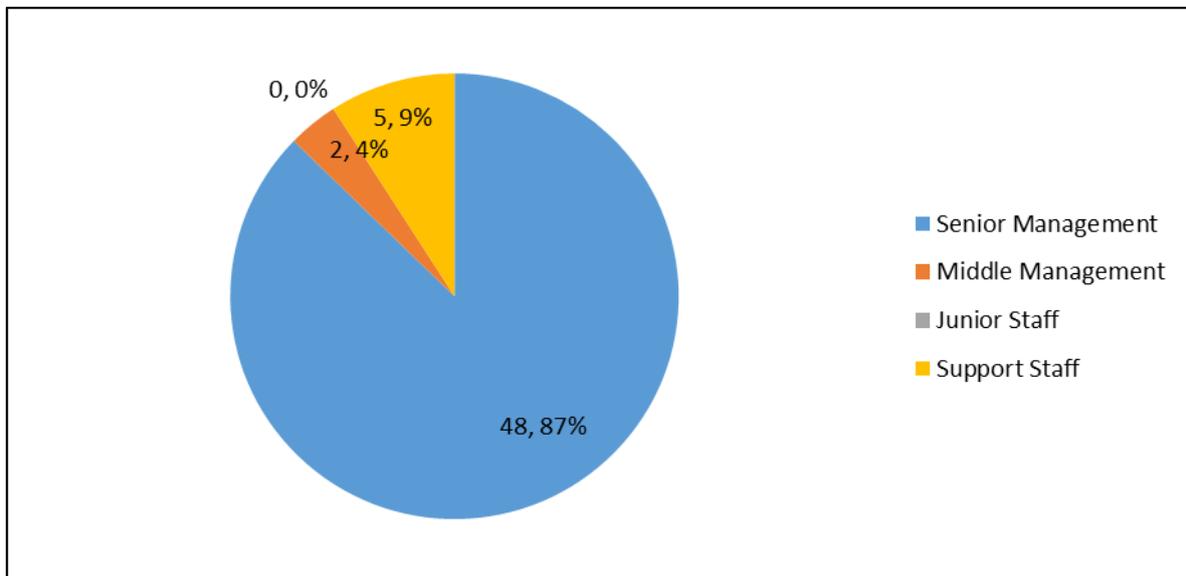


Figure 4 Classification of respondents based on job title

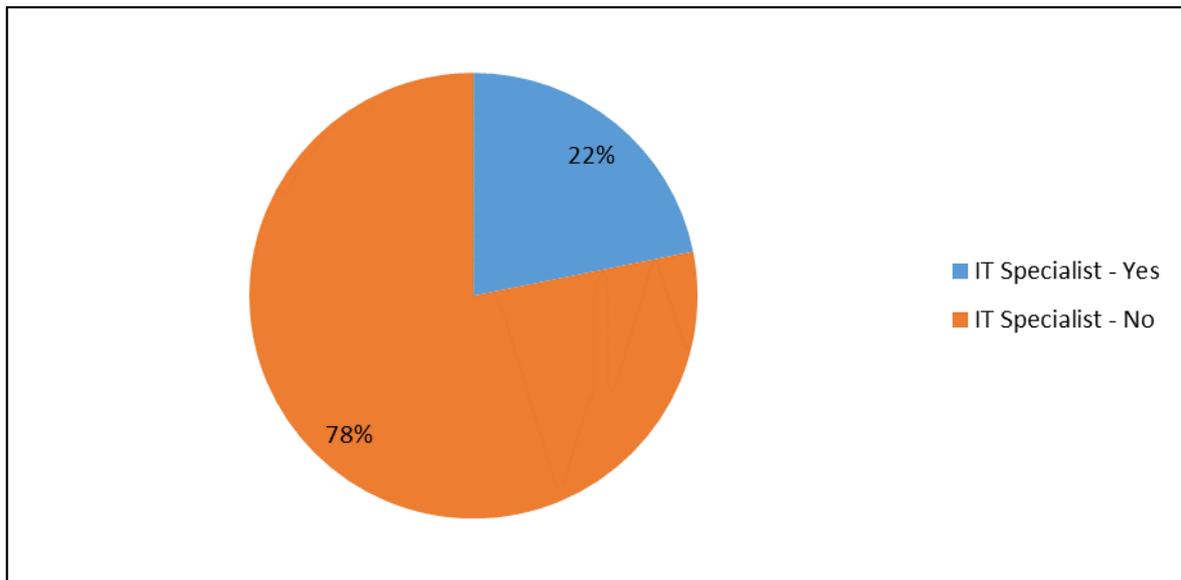


Figure 5 IT Specialist or not

Figure 5 indicates that 22% of the sample work as an IT specialist within the organisation. This indicates that over half (55%) of those working as an IT specialist in the Construction Industry in Bulgaria combine their initial specialism at senior management and middle management with their ICT skills.

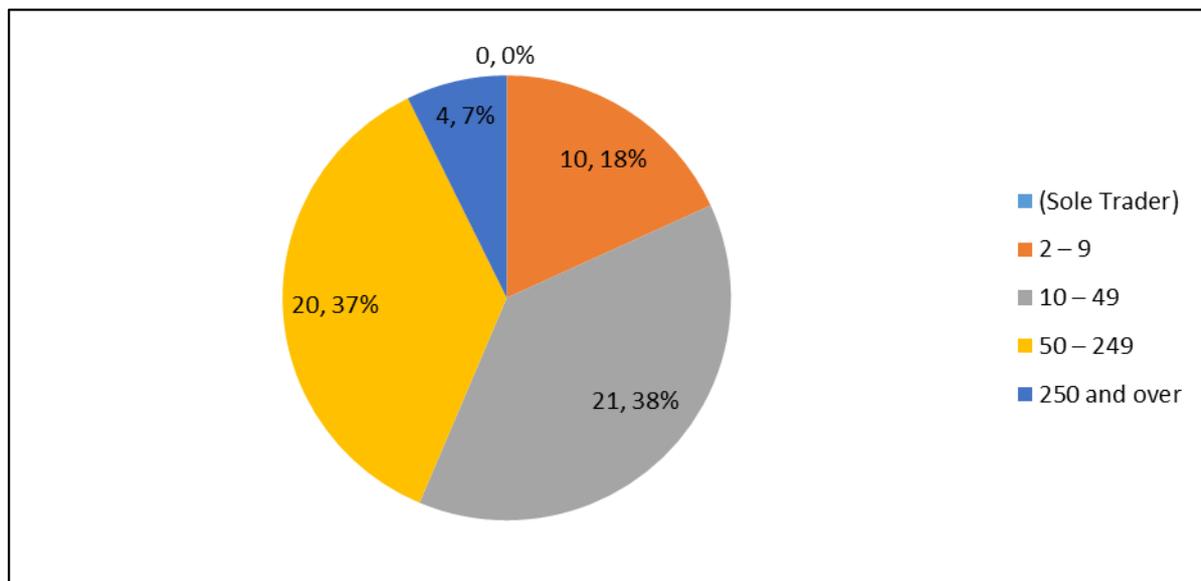


Figure 6 Classification of organisations based on number of employees

Figure 6 indicates that Small to Medium Size Enterprises (SME's) employing 10-249, according to the European definition, dominated the sample with 75% of respondents. Again this correlates to NSI (2016) statistics regarding the size of organisations within Bulgaria and provides a good basis for generalisation.



4.0 Questionnaire Survey Results

The survey results are reported in a structure matching the layout of the questionnaire. Reporting of the findings follows the following structure: e-Business in your organisation; IT investment and e-Skills development; Drivers, impact and barriers of e-Business; Improvement of e-Business and Future of e-Business in your organisation. The applications of ICT in construction are varied and numerous. The findings in this section of the report focus on applications of ICT from an e-Business standpoint. According to Zhua *et al* (2015) the applications of ICT in e-Business are threefold: technical, relational and business components. Each of these elements are examined in the findings of the questionnaire. Enterprise Resource Planning (ERP) systems automate and replace paper based systems and are sometimes used in construction. This report further examines the location of information as Duan *et al* (2012) suggest that hosted and on premise ERP solutions perform differently. The location of information is examined in Section 4.1.2.1. Where licensed software is installed on servers and accessible to in-house employees only this is known as an intranet. Intranets are maintained internally within an organisation and therefore backup and recovery methods are more important than when using extranets or cloud based systems. Extranets provide a similar service through an external organisation with storage space off site (on a server) normally dedicated to the organisation, project or group of collaborating organisations. Tang (2015) examines ERP systems and considers that if integrated with Cloud-based technologies they are more successful. This examination of these methods of storage and document sharing have not been fully examined from a construction context in Bulgaria prior to this report. The findings examine the elements of business sometimes connected via an ERP and determine the importance of each from a construction standpoint.

4.1 e-Business in your organisation

This section of the report examines e-Business elements within organisations. E-Business activities are examined first with emphasis on document management and core activities. Then examination of communication networks used and the level of e-Business usage follows.

4.1.1 e-Business activities

This section ranks different types of documentation that can be made electronic for exchange of information. Figure 7 indicates the degree to which documentation is exchanged electronically within the Bulgarian construction sector. Figure 7 indicates that Administration Documents are evidently exchanged electronically in the greatest amounts with Contract documents ranked second. The rank of Contract Documentation in second place is higher than in the UK (Eadie and Perera, 2016) and indicates that Bulgaria is very progressive in this regard. The high ranking demonstrates that smaller value emailed contracts without a tender process comprise a much higher percentage of Bulgarian contracts compared to those in the UK. The Tender process being ranked in third position substantiates this. The bottom three rankings: plant (16th) and labour (14th) procurement and exchange of design documentation (15th), demonstrate that these elements are not widely used in Bulgaria. This suggests that the efficiencies that they produce are being missed out on and increased adoption of electronic processes in the three areas will produce benefits for organisations. Furthermore, the lack of Building Information Modelling (BIM) shown in Section 4.1.3, further supports poor use of collaborative Common Data Environments in the Bulgarian construction industry for the exchange of design information. When read in conjunction with the Design ranking (15th) it demonstrates the possible impact that the implementation of BIM would have in increasing electronic collaboration and encouraging design stage productivities. Other research, such as Eadie *et al* (2013), has demonstrated from a user perspective the benefits BIM can accrue.

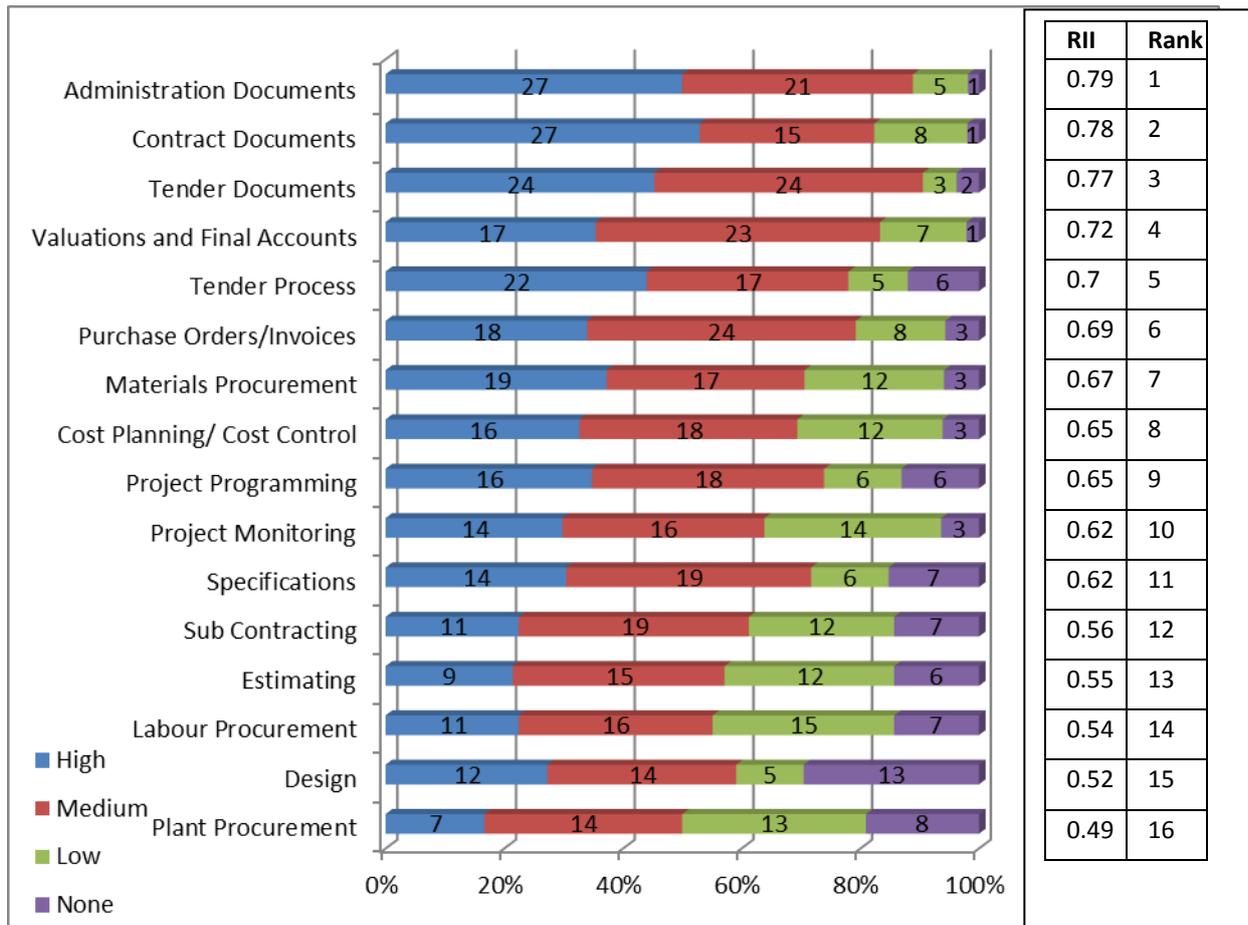


Figure 7 Degree to which construction documents are exchanged electronically

Six of the top seven elements exchanged electronically in the ranking provided in Figure 7 relate to elements within an e-procurement system: Contract Documents, Tender Documents, Valuations and final accounts, the tender process, purchase orders / invoices and materials procurement. Neef (2001) suggested that e-procurement systems using the internet were first developed in the late 1990's using Electronic Data Interchange (EDI) technologies. Its power as a supply chain management tool was realised by Zarli *et al* (2009). Eadie *et al* (2010 a&b) ranked the benefits of a e-procurement system in construction and indicated that "Process, Transaction and Administration Cost Savings" was the greatest benefit. Despite the benefits of adoption Griloa and Jardim-Goncalves (2010) suggested that the construction industry was slow to adopt it. The European Union (EU) has set a targets for the various stages of adoption of e-procurement systems from 2014 (EU, 2016). The findings in Figure 7 indicate that EU deadlines in relation to e-procurement have worked as related electronic procurement documentation now occupies 6 out of the top 7 ranking positions in Figure 7.

Figure 8 provides the results of the examination of e-Business activity in the context of construction firms business based functions. It examines the core financial functions related to construction most used in Bulgaria. Accounting, finance and procurement occupy the top three positions in Figure 8. The ability of an organisation to maintain a balanced financial standing and cash flow is imperative as its very existence relies on this. This has resulted in the use of electronic means for accounting, finance and procurement being ranked as the top three in importance in the ICT core activities in Bulgaria.

Project Management has developed to a situation where contractors are expected to produce an electronic programme as part of the tender process, especially in the UK. This has resulted in bespoke programmes such as Microsoft Project being developed to provide comprehensive scrutiny of project performance when on site. The financial element of the project can also be tracked with project management software producing “S-Curves” and other financial measures to track monies in and out of the project. Furthermore, software has developed for construction which provides financial data related to rental of plant, material costs and salaries. Programming which is included in the project management ranking is therefore recognised and in fourth position. Figure 8 provides the results.

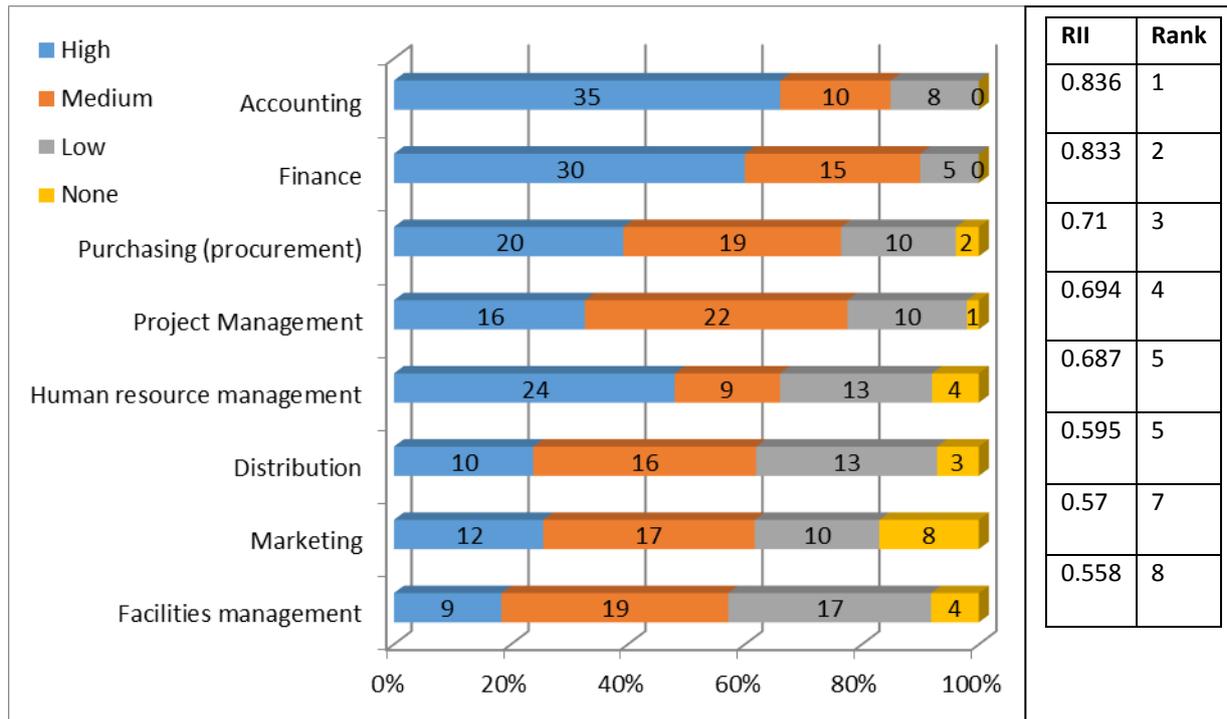


Figure 8 Degree to which core business documents are electronic

Figure 8 surprisingly shows that the least electronically enabled core business element is Facilities Management (FM). This is a comparable result to findings by Eadie et al (2013) that showed FM was the least used element of BIM in the UK. However, Eadie et al (2013) goes on to show that FM is the second most significant element in producing cost savings. If this is conveyed into a Bulgarian context it suggests that this is an element of e-Business that could maximise cost savings for little effort and introduce substantial efficiencies over the life-cycle of the project.

Another disappointing ranking score of 0.57 is the ranking of marketing. Digital marketing came as a result of the internet. Now organisations have moved from paper brochures to a web presence on a website or on social media. Berg (2015) proves that Social Media is one element that construction organisations can exploit to connect with prospective clients and other stakeholders. The benefits are that a large audience with unlimited geographical limits can be accessed with limited financial resources. Web 2.0 technologies like Facebook or Twitter will allow marketing information to be propagated at little or no cost to the organisation. Therefore promoting construction organisation skills and capacities will deliver benefits for construction organisations in Bulgaria.

The third lowest ranking was given to distribution of documentation electronically but this was identified by Alaghbandrad *et al* (2012) as an element providing efficiencies and cost savings when compared to paper based processes. The distribution of documents electronically can result in large monetary savings for example Liao (2002) in Taiwan indicates savings of US\$40 million each year. It is disappointing that the savings are considered less relevant in Bulgaria.

4.1.2 Communications Network

The second internal element investigated by the questionnaire examined the types of network the organisations use and the amount of internal and external communication carried out electronically.

4.1.2.1. Network communication type

The percentage of organisations using one or more, or none of the different types of network are shown in Figure 9. The Intranet at 58% is the largest way of transferring documents on a network. However, of note is that Sky Drives / Cloud Networks are little used in Bulgaria (10%). Bulgaria and the UK are very different in this regard. See Eadie and Perera (2016) where they are widely used in the UK. Cloud-based systems therefore need to build trust in Bulgaria to achieve the same amount of buy-in. The lack of BIM implementation in Bulgaria can be seen as a contributing factor as AutoCAD 360 and other software related to common data environments for construction related activities have moved collaboration to the cloud and this has expanded the use of the cloud in the UK. Re-engineering of processes to include cloud-based BIM has been seen by authors such as Matthews *et al* (2015) to create efficiencies during the construction process. It also indicated that 8% of organisations do not collaborate electronically through either an intranet or an extranet. Substantial benefits could be accrued by these organisations if they adopted intranet use for document management purposes.

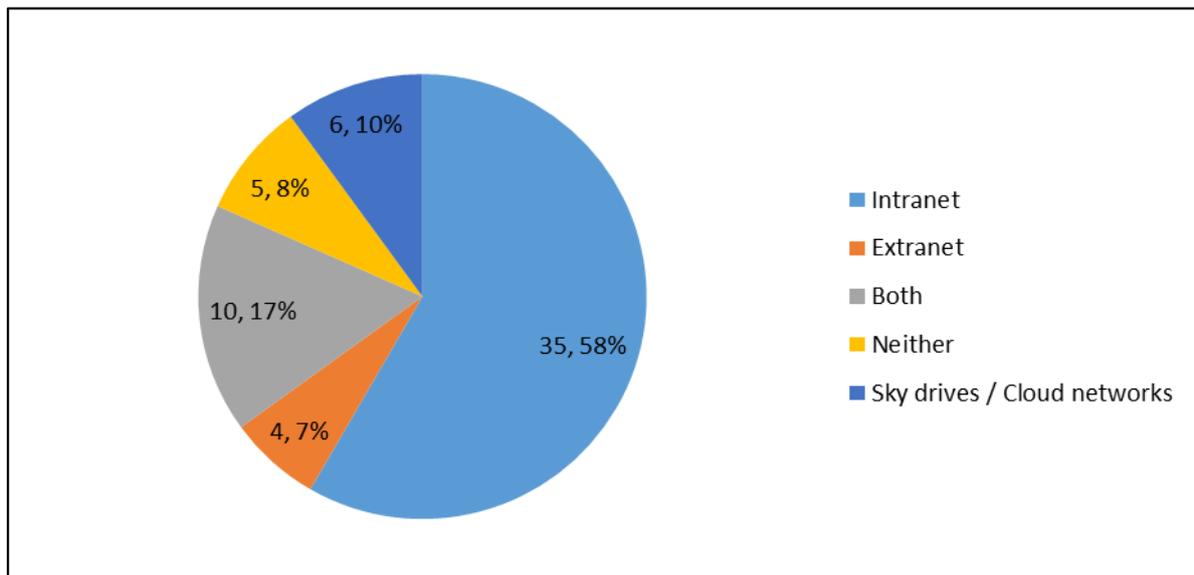


Figure 9 Communication networks in respondent organisations

4.1.2.2. Internal and External Communication Levels

The next section within the organisation examined communication electronically internally and externally. Figure 10 indicates that electronic external communication within an organisation outstripped the internal communication. Internal communication in Bulgaria seems to be verbal or in Face-to-Face format through meetings in Bulgaria.

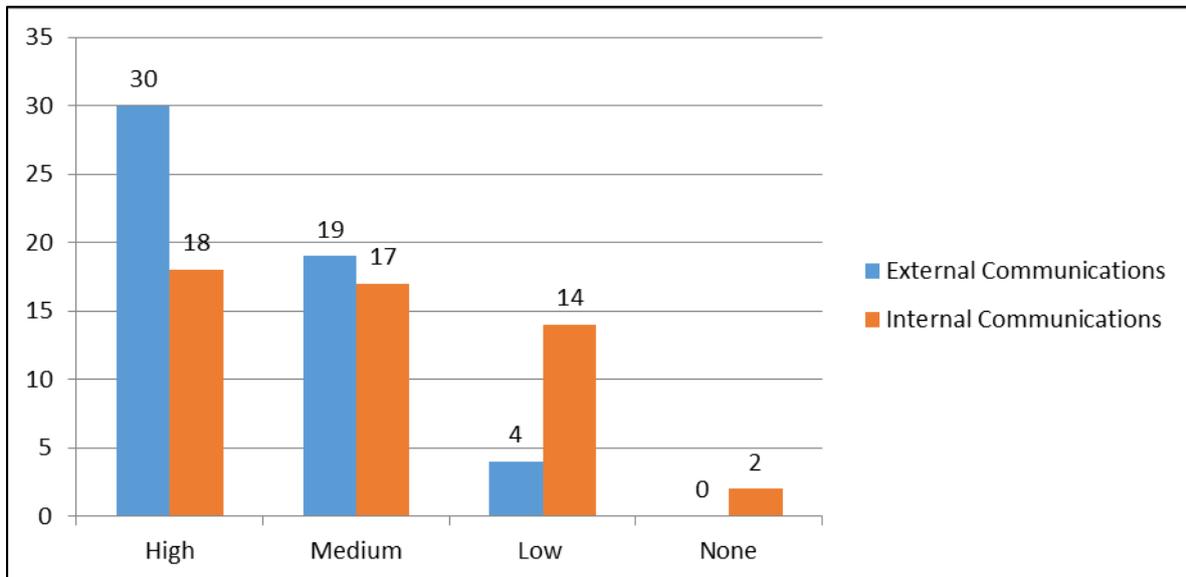
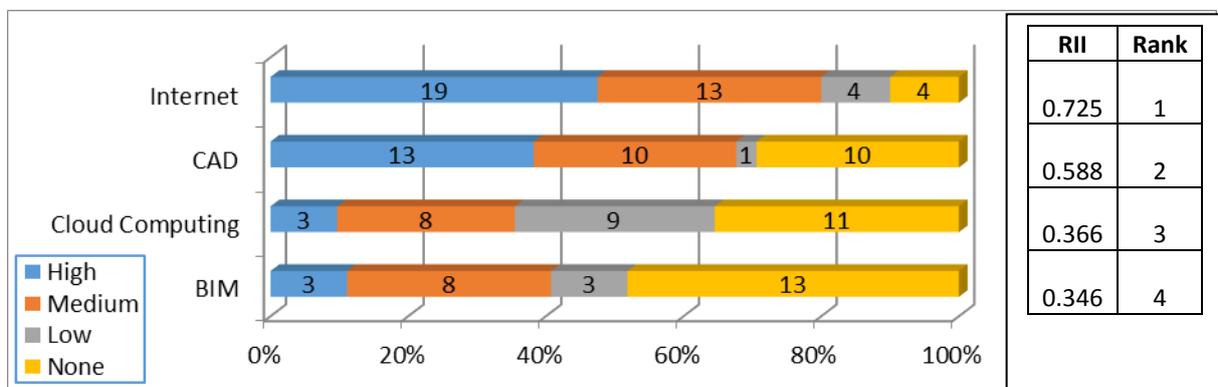


Figure 10 Degree of electronic communication internally and externally

4.1.3 Level of e-Business usage

The use of the internet for e-Business was investigated next. Levels of activity on-line were measured for activities and ranked using the RII formula. The outcome is provided in Figure 11. Ranking using the RII resulted in customer relationship management being the activity organisations used the internet most for. This is surprising given the poor ranking of extranets and BIM (Figure 12). The forced conclusion is that this results directly from company websites which are not seen primarily as a marketing device. A similar conclusion can be drawn from these results to that already mentioned in Section 4.1.1.



RII	Rank
0.725	1
0.588	2
0.366	3
0.346	4

Figure 11 Ranking of preferred activities for internet use

Respondent organisations were then examined in relation to e-Business enabling technologies and quantity of usage in their organisation. Figure 12 provides the results indicating on-line software, supplied via the internet, is the principal e-Business enabling technology used in Bulgaria. Ranked in first position and above AutoCad based systems was anticipated as a much more extensive range of applications covering all aspects of engineering are provided in this way. Financial packages, calculation software for a range of structural, geotechnical and other construction elements can all be sourced on-line. BIM, with all its benefits is ranked in last position in Bulgaria, which indicates that its potential to make savings is still not being fully utilised. The ranked benefits of adopting BIM are discussed in Eadie et al (2013b). Similar benefit utilisation could be reproduced in Bulgaria if organisations made use of OpenBIM software.

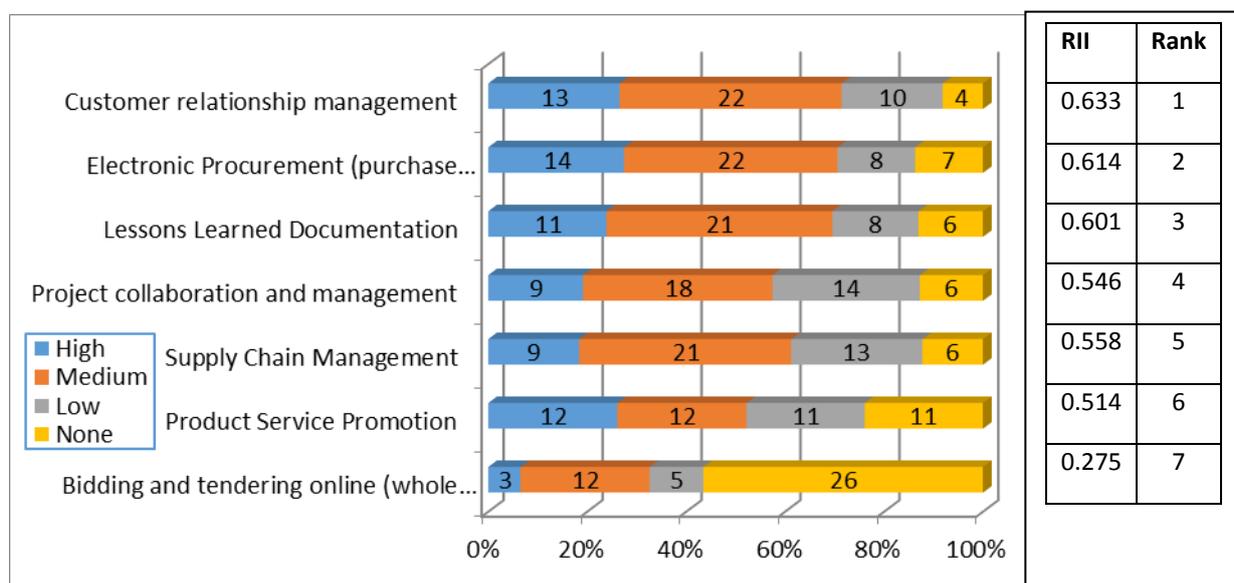


Figure 12 Ranking of preferred e-Business enabling technologies

Cloud-based systems were ranked in third position. These systems are used for file sharing and include companies such as OneDrive, Dropbox, Box, and others. While being used substantially in the UK, little use is being made in Bulgaria. Matthews et al (2015) show that the use of cloud-based BIM using common data environments during construction have realised paperless projects with many paper-based processes being substituted for electronic ones. When paralleled comparatively, while BIM and Cloud computing still remain in the bottom two positions in the UK survey (Eadie and Perera, 2016), they have a much deeper embedment within the construction industry, evidenced in both having RII values above the 0.5 threshold. Therefore in the UK, BIM and Cloud Computing have only slightly less embedment than CAD in the Bulgarian Construction industry. As a result, in relative terms, substantial efficiencies can be gained from deeper adoption of these technologies in Bulgaria with potentially substantial efficiency gains.

4.2 IT investment advice and e-Skills development

The second section under investigation relates to how companies operate and maintain e-Business systems and futureproof the systems. This section covers IT investment advice, IT Expenditure and e-skills development.

4.2.1. IT investment advice

Initially respondents were requested to categorise the source of their IT advice. Figure 13 indicates that the foremost source of IT investment advice comes from the professional IT providers themselves (51%). This could lead to potential conflicts of interest as the salespersons who sell IT are going to promote their own products even though they may be conscious of other providers better suited to the client’s needs. The second issue relates to the salespersons technical and scientific knowhow and how up to date his information on competitor products is. Some salespersons only have training in the software products that are being sold through the company they work for. This makes them vulnerable if they are selling products without qualifications and the associated expertise that studying the specific academic field for a number of years brings. This provides an opportunity for education providers such as universities with their skills to provide expert advice. The research link between Universities and industry is not as developed in Bulgaria as it is in the UK with this being in third place in Figure 13. This further supports the need for development of these links as universities can act as independent unbiased brokers in advising on the best software for the organisation.

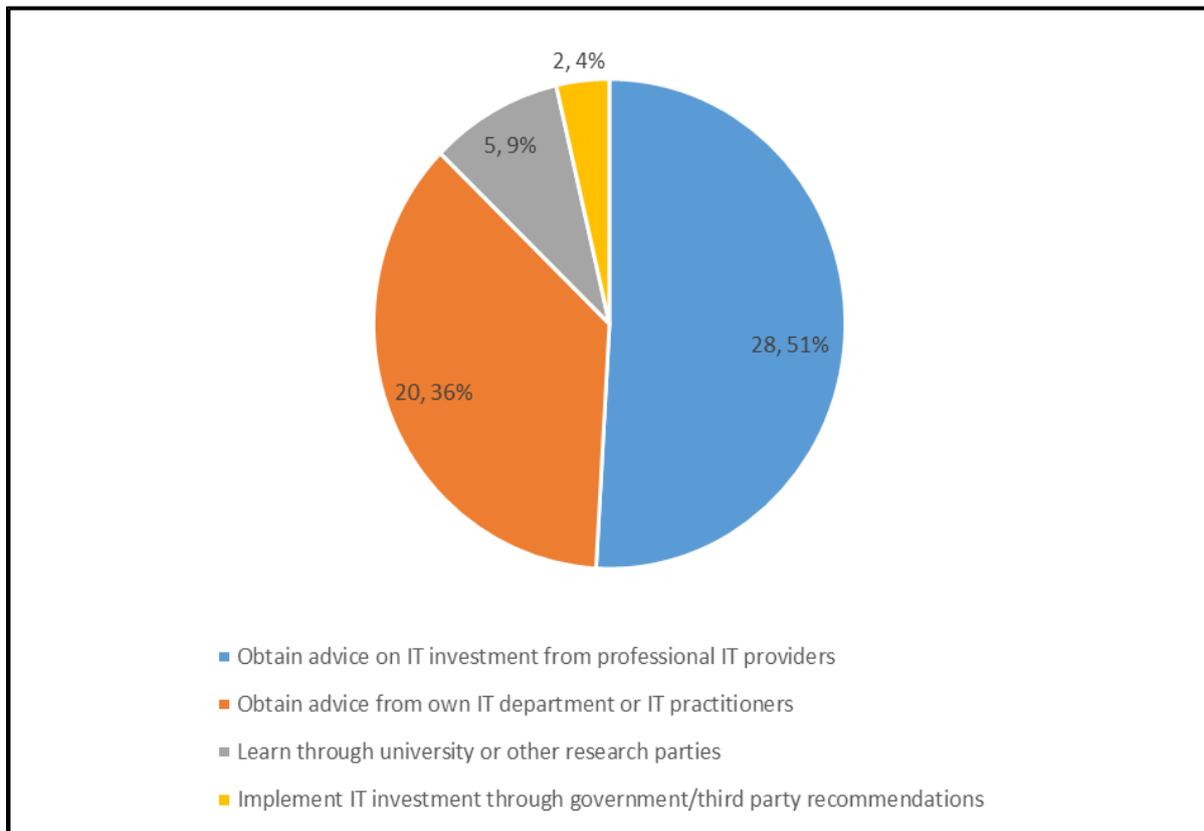


Figure 13 Type of IT investment advice

4.2.2 IT expenditure

This section explores respondent’s annual IT budgets, including spends on hardware, software, services and personnel over the last five years. From Figure 14 it can be seen that in the last 5 years, over three quarters (78.7%) expenditure on IT was between 1-4% of their annual budget. Again, if the top two percentages are added for the last five years, almost 96% (95.7%) percent of

the respondents spent less than 9% of their annual budget on IT. The expenditure on IT in the UK (Eadie and Perera, 2016) at the same level is 88.2% which also represented a situation of underfunding. Until electronic systems are made mandatory in Bulgaria in a similar way to the UK the figure is unlikely to change. In the UK, when BIM was made mandatory for government projects the expenditure levels increased as a percentage of turnover. A similar increase in funding might happen in the near future in Bulgaria due to the mandatory targets set for Government e-procurement (EU, 2016) and other European electronic initiatives.

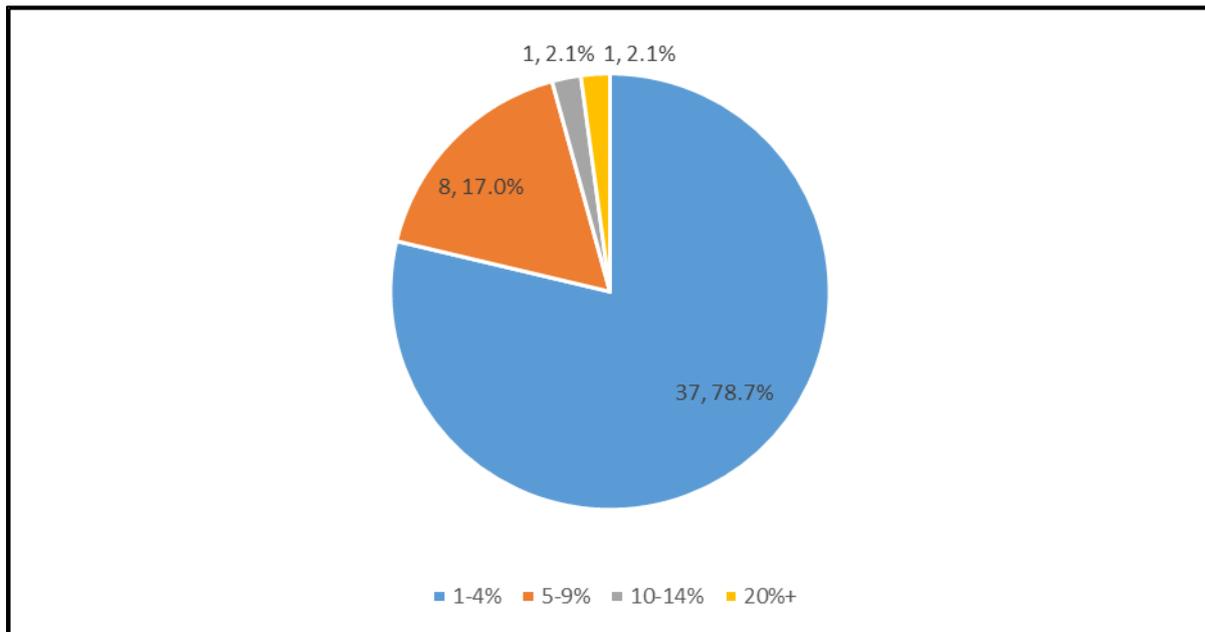


Figure 14 Degree of IT expenditure in the last 5 years

4.2.3 e-Skill Development

Training in IT processes and development of IT skills were the next to be investigated. Three options were provided: Staff learnt new computerised skills through self-learning, Staff attend training courses outside your organisation and The organisation hires IT practitioners to train their staff. Figure 15 presents the results indicating that the majority of staff are self-taught. With a RII value of 0.255, much less than 0.5, stated in Figure 15, companies hiring an IT professional to train staff seems very infrequent in Bulgaria. Figure 15 with the self-learning being so prominent shows the value of “How To” guides, “on-line help” and other literature such as books when it comes to learning new software. These are often complained about with little effort put into their development yet this result indicates that they have pre-eminence in relation to staff members seeking assistance.

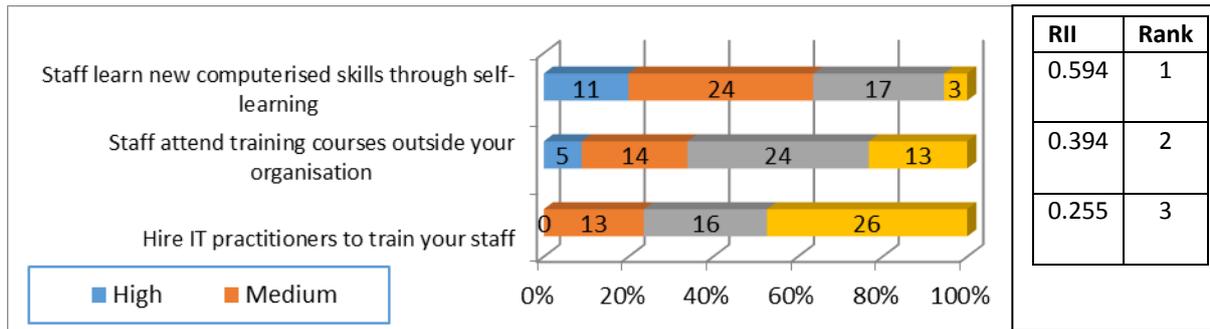


Figure 15 Ranking of e-skills development

4.3 Drivers, Impact and Barriers of e-Business

Section 4.3 of the report analyses the following three elements of e-Business: the drivers for implementation, the impact of its use and the barriers to it being successful.

4.3.1 Drivers for implementing e-Business

The reasons for e-Business adoption were then ranked by the respondents. Figure 16 provides the results in rank order of importance. The competitive advantage that e-Business brings through adoption is the most compelling reason for its adoption in Bulgaria. In second place is customer expectations with the demands of public sector clients needing to be fulfilled to ensure work.

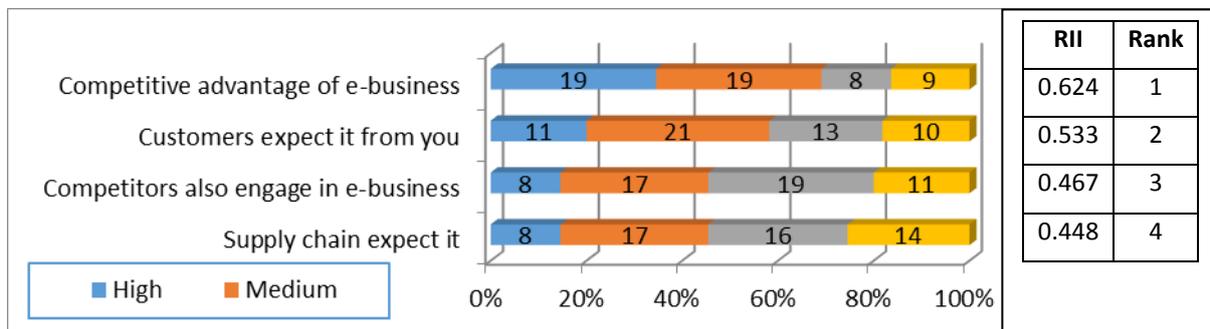


Figure 16 Ranking of reasons for e-Business adoption

Supply chain expectation is at a lower level in Bulgaria than in the UK (Eadie and Perera, 2016). This may indicate that the supply chain is less developed in Bulgaria and is a potential aspect of e-Business that could be more fully examined by future work.

4.3.2 Impact identified for e-Business implementation

The perspectives of respondents in relation to the positive impacts of e-Business were then ranked. Figure 17 provides the importance of each of the factors from the analysis of the results. Figure 17 shows that, in Bulgaria, the accounting and administration aspects of e-Business produce the highest benefits. Figure 17 indicates that management and control encompassing the transparency and visibility of e-Business was ranked second, followed by the time and cost savings in third. The second and third ranked benefits duplicate those in a similar position in the UK (Eadie and Perera, 2016). In fourth and fifth positions respectively, productivity and Internal Organisation, show the benefits are not the topmost priority within Bulgarian Construction organisations. The maturity of the embedment

of each of the factors needs further work, with the application of a maturity model such as one of those identified in Eadie et al (2011).

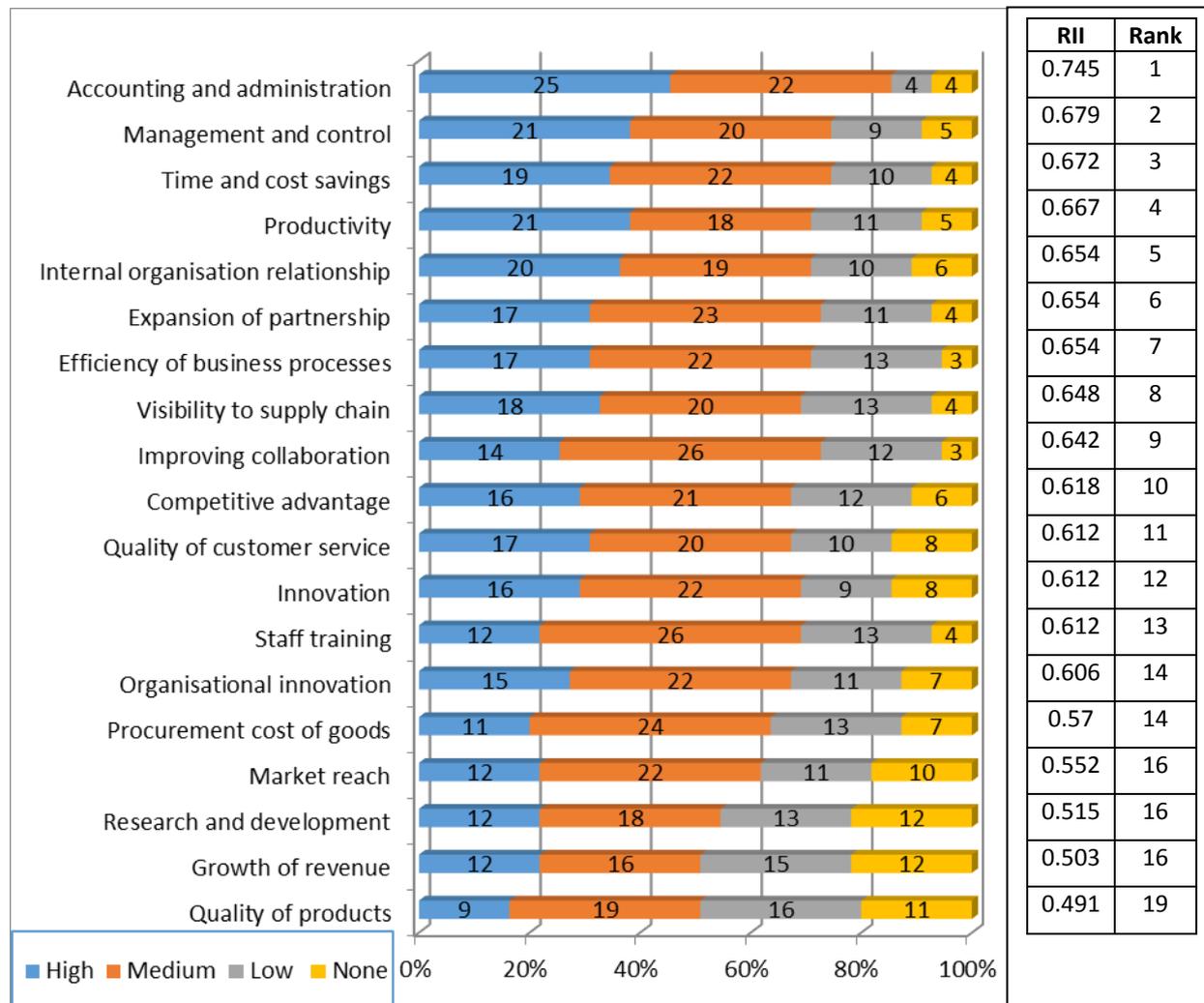


Figure 17 Ranking of impact of e-Business

4.3.3 Barriers to e-Business implementation

As complete adoption of electronic systems has not been achieved in Bulgaria there are issues (called barriers) that need to be addressed. In order to overcome these, the importance of these issues must be evaluated. In this section of the report organisations provided importance ranks for these issues. See figure 18. In Bulgaria, the availability of professional software and the associated costs of the software were ranked in first and second positions as the most important barriers. The availability of open source freeware in the Bulgarian language would have a substantial impact on the uptake of e-Business across the country. Legacy systems of old USSR vintage and others imported from current day Russia are used in Bulgaria. These systems tend to be difficult to integrate with Western systems and this challenge has given rise to “Modification of Legacy systems” taking third place in the rankings. Additional research into the interoperability issues with possible modifications would again result in increased uptake of e-Business if solutions could be found. “Lack of Technical Skills” is ranked in fourth position. The findings of Section 4.2 are further supported with opportunities for education and

training organisations evident. The Bulgarian government might wish to look at the costs of this training, with perhaps subsidies, in order to mitigate the costs issue ranked second.

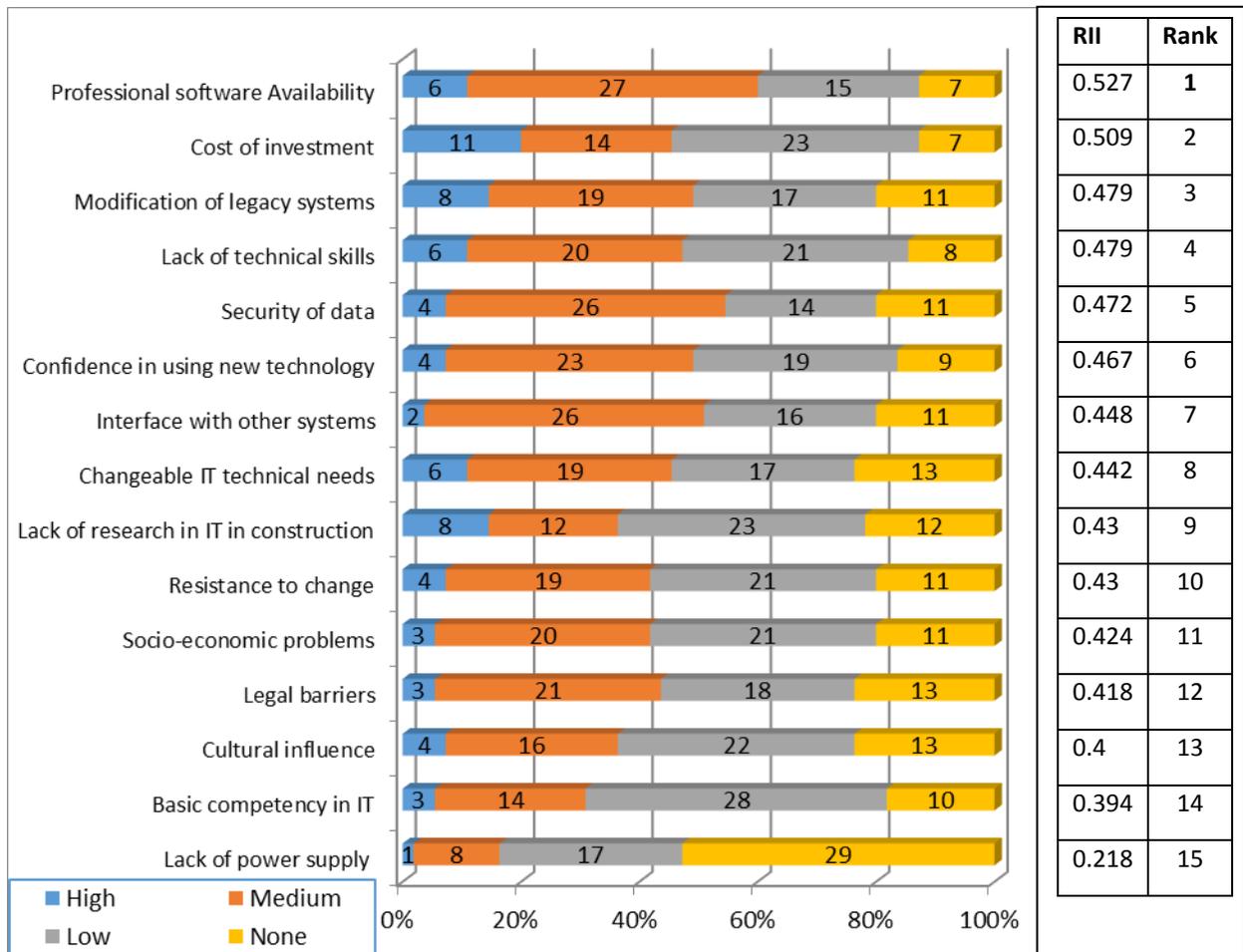


Figure 18 Ranking of barriers of e-Business

4.4 Improvement of e-Business

4.4.1 Internal resources

The next section of the report investigates how organisations intend to improve e-Business adoption in Bulgaria. The allocation of where funds should be spent internally was examined. Figure 19 indicated that the most frequently used internal resource to improve e-Business was training for working staff which supports previous findings in this report and further suggests that people and not software packages are critical to the adoption of e-Business in the construction sector. In second place was expenditure in IT infrastructure. The previous sections indicated an underfunding in relation to total budgets and that the costs were prohibitive. This shows that this finding also supports the position of seeking some sort of Government funding in relation to the creation of efficiencies through e-Business. Increasing the amount of IT staff or getting professional help during the implementation process was placed third again emphasising the

need for universities and training providers to produce skilled personnel and graduates who are employable in order bring efficiencies to the employing organisations.

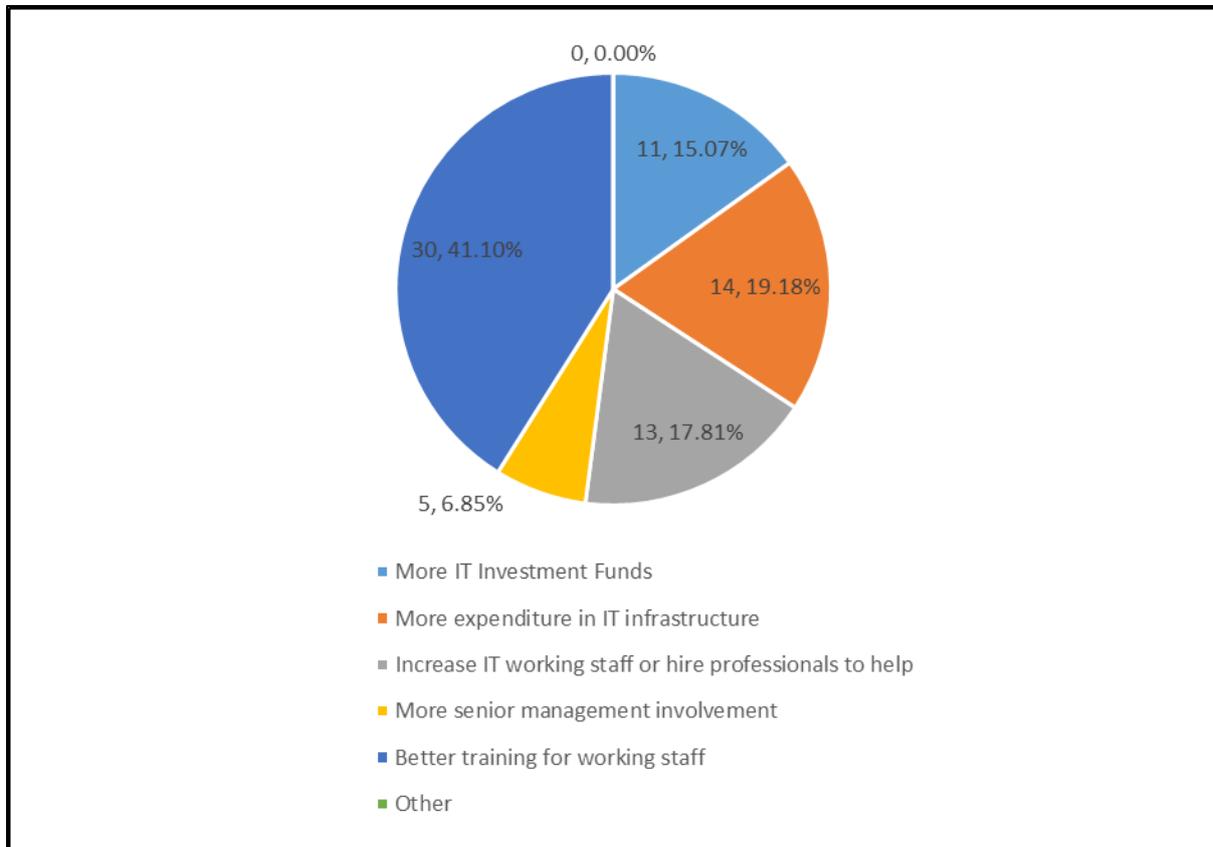


Figure 19 Organisation’s internal resources used in improving e-Business

4.4.2 Business process

Organisations were then requested to select the statements that best define their organisation’s desire to improve e-Business with regard to business processes. Figure 20 suggests that the best way from a business sense to improve e-Business is the integration of e-Business processes. Interoperability issues between e-Business solutions and e-procurement has previously been raised as a problem by Eadie and McClean (2015). Fully interoperable systems produce a seamless link and therefore negate the need for data re-entry and time-consuming administration. The second highest improvement considered is the automation of different business processes. As a result, key aspects to be addressed by future research in Bulgaria are interoperability and automation.

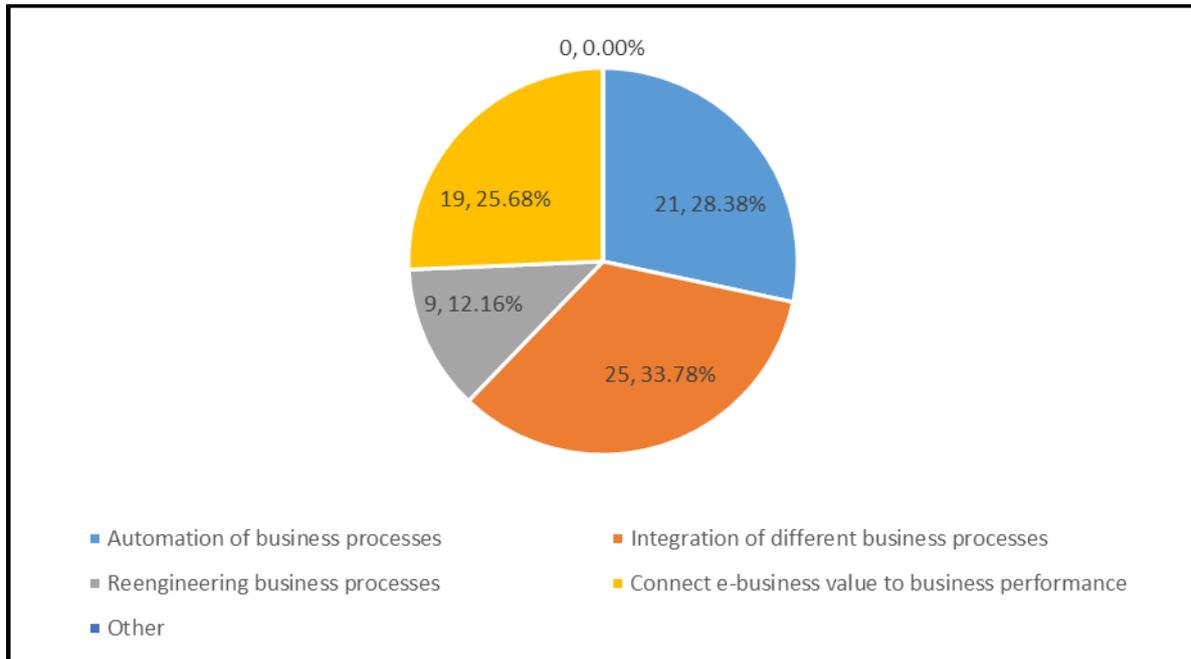


Figure 20 organisation’s business processes used in improving e-Business

4.4.3 Organisational culture

Organisational culture in Bulgaria was not seen to negatively impact on adoption as it was ranked 13 out of 15 in Figure 18. However, as everything can be improved this was investigated. Figure 21 indicates that the two most important cultural changes in support of e-Business adoption relate directly to the systems and people involved: to recognise the benefits and importance of using e-Business and to encourage staff to use e-Business tools.

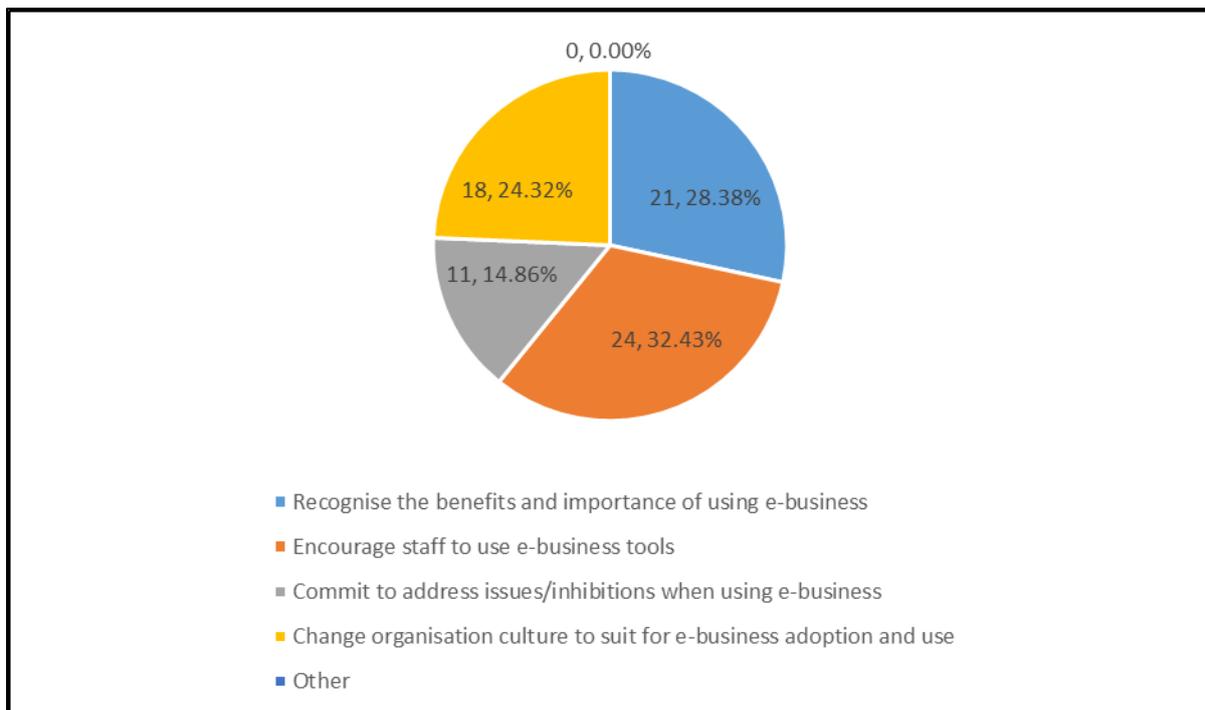


Figure 21 organisation’s cultural elements used in improving e-Business

4.4.4 Business Goals

In the last part of this section, respondent organisations were asked to **select one** statement that best described their organisation’s desire to improve e-Business through setting business goals. Figure 23 shows the three statements regarding different business policies that could be adopted by the organisations. Figure 23 clearly indicates that with 56%, e-Business policy integrated with the overall business goal was the favoured process that was used with only 11% of organisations suggesting that no integration exists.

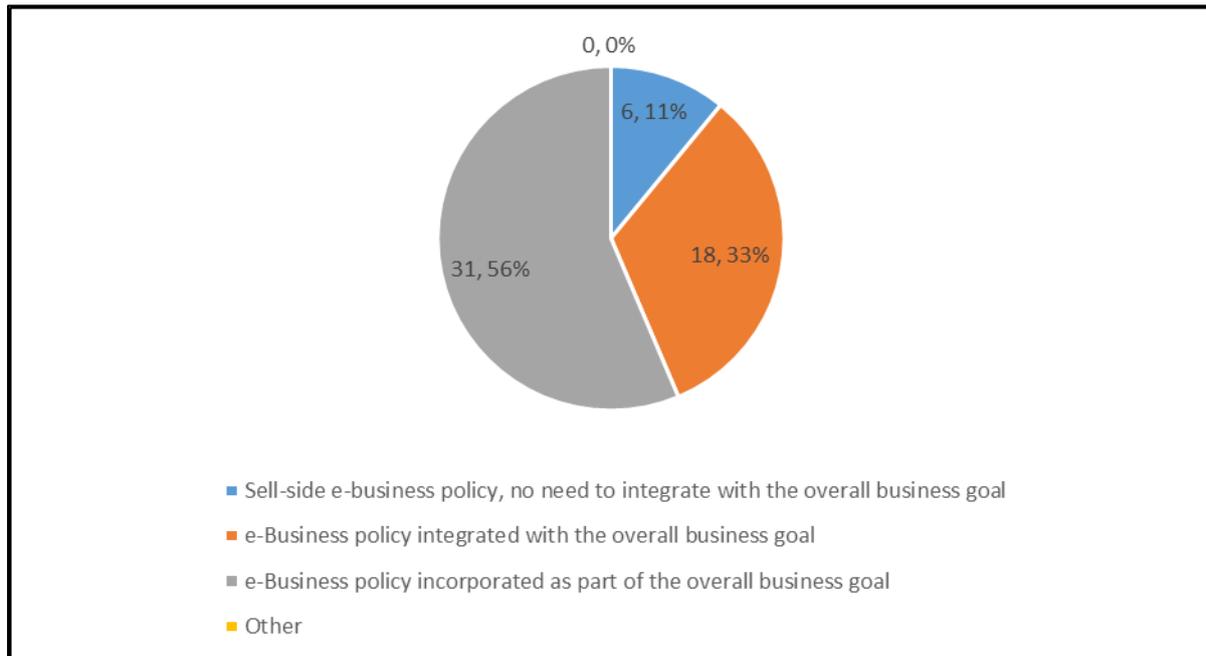


Figure 22 organisation’s business goals used in improving e-Business

4.5 Future of e-Business in your organisation

Future proofing of e-Business processes, keeping the organisation up to date in relation to e-Business in relation to future investment policy for e-Business in the respondent organisations and when they intended to launch an e-Business policy is examined in this section of the report.

4.5.1 Future investment in e-Business

Investment is important in relation to e-Business to keep the software and systems up-to-date. Respondents were asked to select one statement that best describe when their organisation’s next financial commitment to e-Business would be made. It can be seen from Figure 23 that the results indicate that nearly a fifth (18.18%) of Bulgarian organisations had no plans to invest in ICT solutions. Of the remainder, 29.09% had pushed expenditure on ICT to 1.5 to 2 years in the future. Only 12.73% were intending investing in the following 6 months. What is positive is that the biggest amount of investment in ICT systems was in the period 6 months to a year from the time of the questionnaire with 32.73% of organisations intending to invest in this timeframe.

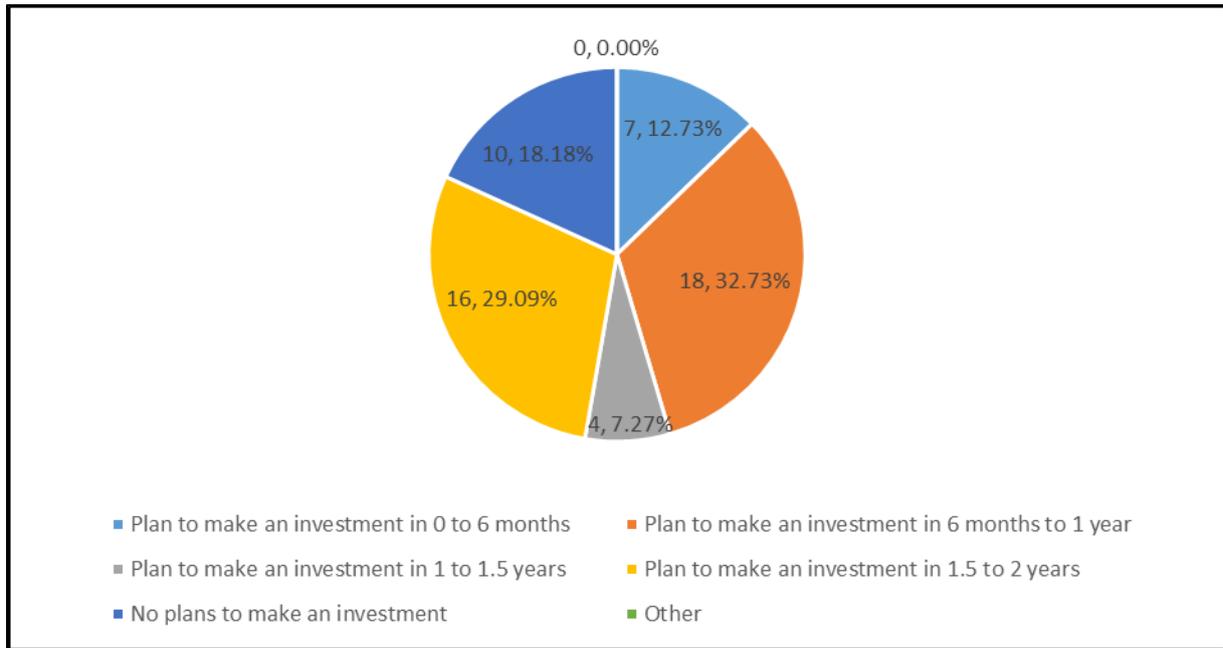


Figure 23 Planned future investment in e-Business

4.5.2 Launch of e-Business policy

Lastly respondent organisations were asked about their views on e-Business implementation policy and what time frame the policy covered. Some organisations had policies covering different timescales including one organisation that had a short, medium and long-term policy. Figure 24 shows that 31.58% of organisations have a short term plan (up to two years) in place. However, in comparing Bulgaria to the UK, a bigger number of organisations in Bulgaria, 35.09% against 30% respectively, are unsure as to whether they will implement an e-Business strategy. In order to benefit from promotional opportunities and possible EU funding, organisations need to be aware of their current requirements and medium and long term goals.

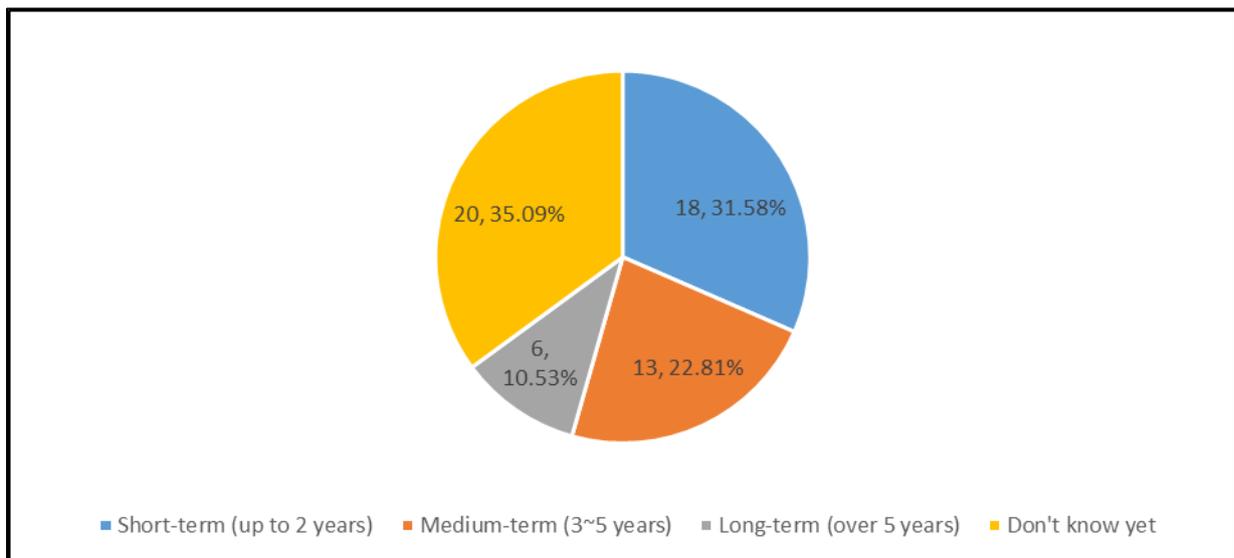


Figure 24 Planned Launch date for an e-Business strategy



5.0 Summary and Key Findings

This section provides a summary of the key findings of the report.

- The type of documentation most frequently exchanged electronically in Bulgaria is related to administration processes. The amount of administration documents exchanged electronically with high frequency (49%) indicates Bulgaria is slightly more electronic than the UK (42%) (Eadie and Perera, 2016) and Canada (30%) (Bowmaster et al, 2016) but similar to Australia (49%) (Gajendran and Perera, 2016). This confirms that Bulgaria matches other economies in relation to e-Business use. The high rise in email for communication over the last number of years is a contributing factor to this.
- At the moment within Bulgaria only a small amount of electronic documentation exists during the design, estimating and sub-contracting stages of a project. This provides a target area which would add efficiencies to Bulgarian companies if implemented more often. High use of BIM on construction projects is small in Bulgaria (11%) when compared to the UK (33%) (Eadie and Perera, 2016), but this is bigger than in Canada (Bowmaster et al, 2016) (7%). The ranked benefits of adopting BIM are discussed in Eadie et al (2013b). Similar benefit utilisation could be reproduced in Bulgaria if organisations made use of OpenBIM software. This would solve issues through clash detection and programming in the Bulgarian construction sector before the project gets to site.
- In Bulgaria, the accounting and finance elements of construction organisations are the two areas most likely to have electronic systems. Furthermore, the report indicates that facilities management (FM), estimating and sub-contracting are some of the least electronically enabled core business elements. This aligns with Eadie et al (2013) conclusions which show Facilities Management is the smallest used constituent of BIM, but is the second most substantial for cost savings. Therefore, targeting Facilities Management aspects of e-Business where Bulgarian organisations could make cost savings.
- Little use is made of cloud based systems in Bulgaria and movement to these could further benefit Bulgarian Construction organisations in relation to file sharing and communication through common data environments. Some organisations provide these free of charge. In all the other countries surveyed (UK, Canada, Australia etc.), cloud computing is used more extensively, with the exception of Ghana. It is proposed that Bulgaria should follow in this regard.
- The findings indicate that there is a shortage of investment in ICT skills development within Bulgaria. This mirrors what is happening in other countries. The majority of staff in the construction industry self-learned ICT skills. Self-learning is 23% higher than staff going on external courses. This is a wider gap than the other countries surveyed, again with the exception of Ghana. It is therefore concluded that on-line and paper-based manuals and step-by-step help guides are required to be user friendly and up to date for all e-Business systems.



- The implications of the high level of self-learning are:-
 - That universities and training providers can step in as impartial advisors to provide advice and training on the types of software best suited to Bulgarian organisations
 - That software developers should seek to make manuals and on-line help as self-explanatory as possible.
- Construction organisations rely on professional IT providers for investment advice. This may highlight a conflict of interest as they may not have the expertise or knowledge of other systems and only sell what they get a commission for. This indicates a role for an independent third party to ensure that organisations get the best fit e-Business software. There is also scope for SaaS (Software as a Service) suppliers to move into the market to fulfil ICT needs of construction organisations as the majority of Bulgarian construction organisations work through the internet.
- Investment in IT systems is low in Bulgaria with 96% of organisations spending less than 9% of their total company costs on IT systems over the last 5 years. This compares to 88% UK, 86% Canada, and 49% in Australia. It can be seen that Australia has invested heavily in IT to make it more efficient and the other countries are investing less. This lack of investment needs to be addressed as realisation of the potential benefits is often dependent on focused investment. In addition to Bulgaria having the least investment in IT of the surveyed countries, it has the longest time before investment is due to be made in electronic systems and the most organisations without an IT policy.
- Improvement of e-Business adoption within organisations was examined under 3 headings: internal resources, which identified funding as the major way to improve e-Business implementation, business process reengineering, which identified integration of systems as a way of improving e-Business within the organisation, organisational culture, which again considered the encouragement of staff to use e-Business tools as a way to increase their use. In this regard, grants from the EU and the Bulgarian government can speed up adoption of e-Business activity. The integration of business processes being ranked highest shows the importance of interoperability especially with many legacy systems and ones being used from the USSR which no longer integrate with modern systems. Software developers should concentrate on providing fully interoperable solutions.
- The final element examined was in relation to e-Business goals. The findings show that Bulgarian Construction Companies are progressive suggesting that e-Business should be completely integrated with the overall goal of the business making it an integral part of any strategy.



6.0 Way Forward

This report suggests that further promotion of e-Business in the Bulgarian construction industry will bring benefits in terms of efficiencies and sharing of data especially on international projects. Once the findings and conclusions are implemented then the benefits will be accrued. Further research needs to be conducted again at that stage to show the impacts on the industry and accurately measure the impacts of the steps taken. Such work needs to analyse legacy issues in relation to interoperability and how to best stop time consuming data re-entry on a variety of systems.



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