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Social Housing Supply Chains and **B**rexit

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Executive Summary

Brexit is set to have tremendous impacts on the entire UK economy. The social housing sector is particularly vulnerable as it is not possible to pass on additional costs to the end user and the occupants of social housing are particularly vulnerable. Consequently, social housing is especially sensitive to the volatility that can be caused by the myriad of small and large changes that are associated with Brexit.

Impacts from Brexit were felt as early as the day after the vote. The devaluation of the pound and decisions to tighten credit quickly impacted the social housing supply chain both directly and indirectly. Uncertainty, volatility and unanticipated consequences will continue to impact social housing supply chains for many years. These changes are too large to deal with successfully with a reactive muddle through approach. Consequently, it is important to consider the sorts of impacts that can occur and how to best prepare to adapt to the new environment and exploit the opportunities it provides. To support this goal, this report considers different aspects of the supply chain: financial, materials, logistics, people, infrastructure, technology, regulation and policy.

In the past, inefficiencies have existed in supply chains – lack of integration and coordination for example – as the market was sufficiently stable and profitable in the past that these overlooked opportunities were not so important. However faced with extreme volatility in currency and an uncertain investment and operating climate, it is now important that inefficiencies be eliminated and supply chain partners work to make communications and the system in general more effective. Opportunities associated with industrial strategy, digitization strategy and the sector deal are also noted.

With communication, coordination and experimentation the challenges of Brexit can be translated into opportunities. This report attempts to start the process by better identifying a number of risks, opportunities and likely consequences of Brexit.

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Introduction

Mark Carney the Governor of the Bank of England indicated on BBC News on the 20th of April that “The biggest set of economic decisions over the course of the next few years are going to be taken in the Brexit negotiations and whatever deal we end up with. And then we will adjust to the impact of those decisions in order to keep the economy on a stable path”. This research proposal sets to support this adjustment through appropriate research and application of knowledge to the generation and implementation of new regulation impacting the social housing sector.

The construction, maintenance and operation of social housing is an exemplar of sectoral impact in the UK as it involves both social and economic benefit. Insights gained here can be utilized in other sectors, including the public sector that involve social considerations, and in sectors that involve the assembly of multiple components produced by many different actors – such as transportation and consumer goods. Not only does construction offer generalizable insights to many other important parts of the UK economy, but construction is one of the largest sectors with a turnover of £370 billion, contributing £138 billion in value added to the UK economy and employing 3.1 million people (9% of the total UK workforce) (UK_GOVERNMENT 2017). Not only does construction have to face the uncertainties of Brexit; but has additional challenges in planning the right homes to help people now, building them faster, and diversifying participation of partners in the supply of services and utilization of innovations and innovative techniques (UK_GOVERNMENT 2017). Tools such as the £2.3 billion Housing Infrastructure fund (UK_GOVERNMENT 2017) and the utilization of the public sector spend of £268 billion per year (14% of GDP) for strategic procurement and the Industrial Strategy as a whole (UK_GOVERNMENT 2017) are proposed to assist in reaching national objectives.

Economic challenges and proposed solutions within The Industrial Strategy linked to Social Housing supply chains (UK_GOVERNMENT 2017) are:

- Government trade and inward investment policies can open up markets for UK trade.
- Economic imbalances between different parts of Britain are too large.
- A system of technical education for young people who do not go to university and better options for those already in the workforce – construction is a key area for non-graduates.
- Many businesses face barriers to scaling up.
- Stimulating innovation through government procurement
- Supporting economic growth through better procurement practices through a “balanced scorecard approach” – encouraging consideration of social and economic factors.
- Ensuring major government procurement projects are structured to support productivity improvements, so that UK firms are better positioned to compete – EU procurement laws hamper efforts to use small business, build locally and minimize red tape
- Accelerating growth across the value chain - by identifying where the greatest value the greatest value can be gained from technology development and investment.

- Develop a deal with Government, by showing how companies within the sector could take actions to transform their strategic prospects and how the Government could increase the prospects of success

However, without more insight into the possible impact of Brexit, the meeting of ambitious goals with programs and strategies will be at best accidental. Overall housing is a national priority as it is a key factor in driving economic growth (UK_GOVERNMENT 2017). The Pillars of the Industrial Strategy – 2. Developing Skills, 5. Improving Procurement and 10. Creating the right institutions to bring together sectors and place (UK_GOVERNMENT 2017) – call for a multi-method research approach that utilizes supply chains as a level of analysis to better understand how to maximize the social and economic priorities of stakeholders.

Re:allies are concerned that, changes in regulation (including planning), currency fluctuations, supply of materials and labour could all influence speed and structure of the supply chain, thereby impacting on the implementation of government housing and construction policy, and internal medium and long-term planning. For determining the complex interplay of positive and negative factors, qualitative research techniques that allow for exploration of the richness of personal experience and the underlying themes and constructs is advisable.

This report summarizes the interaction between Brexit and the Social Housing supply chain in regards to a variety of impacts: financial, materials, people, information, infrastructure and technology. The role of uncertainty is considered as well as the different perspectives and concerns associated with different stakeholders. Brexit adds to the likelihood and magnitude of changes facing Social Housing and the supply chains that support it.

In addition to the uncertainties associated to Brexit the impact of the Grenfell Fire Disaster has already been noted by supply chain partners, as substantial funds have been redirected from anticipated purchases to activities associated with fire safety and protection. While the Grenfell Fire is unrelated to Brexit, it is worth noting as it is indicative of the impact that unanticipated events have on a sector that operates on fixed budgets and lacks contingency funding to respond to unanticipated and sudden outcomes. With fiscal budgets that are designed to operate in a stable environment, it is important that the challenges, opportunities and risks associated with Brexit are understood as fully as possible, so that plans can be put in place as much as beforehand to better reflect the budgeting and operating realities of the social housing sector.

The uncertainties associated to Brexit and the nature of Social Housing supply chain are now considered.

Uncertainty

1. Budgets

It is critical to recognize that the Social Housing sector is setup with an implicit assumption of a risk free environment. Budgets must be spent and not exceeded. Clearly even in the best of times uncertainty exists. This uncertainty is dealt with by deferring purchase commitments towards the

latter part of the budget year. In cases in which unexpected costs are below anticipated, future commitments on additional materials, equipment and services are moved forward. While this uncertainty is a nuisance to deal with the supply chain is accustomed to this and structured to address this tendency. Historically, the supply chain partners are accustomed for fixed price guarantees for one year or longer as this simplifies planning and deferred purchase decisions by social housing operators.

Any events that eject additional variability into the system create challenges. Recent examples of such variability are an active new build housing market, Grenfell Fire Disaster and Brexit. All of these events impact different expectations, requirements and elements of the supply chain resulting in variability that must be managed with a fixed budget. For the purpose of this report only the impact of Brexit on uncertainty relating to the Social Housing supply chain is considered here.

2. Currency and Economy

The Brexit vote had an immediate impact on perceptions of currency and economic risk. The pound not only plummeted in value, but its behavior has been much more volatile responding to various announcements related to Brexit negotiations, consumer confidence and related inputs. The overall impact is to greatly increase volatility in the system. By recognizing that the environment has changed so that there are more special circumstances that will no longer allow for reliance on what has worked in the past, the challenges can be minimized and opportunities can be recognized. For example, one supplier noted that their service provider that insures their receivables is becoming more cautious about granting credit. In response to this, the firm changed their collection procedures to remind customers to pay their accounts on a quicker basis than they had previously. The firm reports that their cash flow is now better as they are receiving payment faster than before.

3. Housing Price Shock

While the impact of policy decisions, such as Brexit, on housing prices is not directly related to the social housing sector, it is worth mentioning as private sector housing to some extent relies on the same infrastructure and competes for resources. Therefore, in the absence of competition from private housing, social housing providers may benefit from labour availability and greater flexibility in product pricing. However, in the medium to long term there could be negative impacts as investments in supply chain and other forms of infrastructure that supports the sector will decline. Hence the activity in the private for-profit sector has an influence on the experiences of social housing users and providers.

Also worth noting is the tremendous impact that government policy has on both social and private sector housing. Government programs can rapidly increase/decrease prices. Policy makers are often unaware of the direct and indirect impact of a change in regulations on house prices and behavior, viability and sustainability of firms and other organizations. For example, regulations in Canada to discourage speculative purchasing by foreign nationals, brought abrupt

declines in housing prices in the Toronto and Vancouver markets. Economic sanctions imposed on Russia brought a temporary escalation of Moscow house prices followed by a larger longer decline. In the UK, imposition of a stamp duty tax resulted in a pre-imposition escalation in house purchasing, followed by a substantial decrease in for-sale inventory of houses with a similar decline in sales/purchases.

While government considers policy and regulatory changes to be a positive way in which to protect the public and stimulate industry, policy and regulatory changes disrupt the balance that is naturally sought in this and other sectors of the economy. Changes in regulation are easier for the sector and its supply chain to absorb as they tend to be permanent. Temporary changes in policy are more problematic as these involve the introduction of a new set of rules that must be adapted to and then the removal or some of these rules at a point in the future. The disruptions associated with time limited policies or multi-step change in policy provide tremendous stress on parts or all of the social housing sector supply chain. This is a particular issue with Brexit as the government is trying to maintain flexibility for negotiation and discussing a multiple stage approach. Such an approach requires the supply chain to address, weather and attempt to optimize operations and decision making for multiple changes over an extended period of time. Such a requirement is likely to delay investment decisions – until the system settles into a steady state – and potentially destroy firms that are already in distress. This is not an empty statement as interviewees have described some firms as being a single bad debt away from insolvency.

Method

Discussions regarding the impact of currency volatility, trade barriers and economic sanctions were discussed with experts from Russia and Canada by the research team prior to the development of the interview guide to gain an understanding of system shocks experienced by other economies. Russia has experienced currency volatility and economic sanctions for over a decade. Canada's currency has migrated from being tightly tied to the US economy to being an oil economy. Hence when the price of oil has declined in the recent past, Canada suffered the same sorts of currency shocks as have been seen in the UK post-Brexit. This input combined with decades of research experience was used to develop the interview guide.

The interview guide was developed listing the topics that should be covered during the interview process. Interviews were conducted in a semi-structured format. After a brief explanation of the interview process, interviewees were encouraged to discuss what he/she feels is important. The interviewer will ask questions to get clarification and greater detail on some items raised. Any items that are not mentioned by the interviewee, but are present on the survey guide will be mentioned to the interviewee to ensure that all topics are covered before the interview ends.

The interview process began with a set of five telephone interviews with high level stakeholders who have an understanding of policy and management issues not only regarding the supply chain, but also more broadly about the sector. Notes were taken during the interview process. The interview guide was then revisited and adjustments were made to reflect the additional insights provided by the interviewees.

A series of 15 interviews were then conducted with members of the supply chain. Purposive sampling was conducted. That is, firms were selected to ensure that firms with different characteristics were selected: manufacturers, distributors, firm size, UK/foreign ownership, nature of product. The intent is to ensure that all the different perspectives and views of the challenges, concerns and opportunities are identified. The selection of interviewees also ensured that multiple firms with each of the characteristics concerned were selected to avoid bias. In four cases, interviews involved discussion with two representatives of an organization at the same time. During the interview, one interviewer – Professor Jonathan Linton – focused on asking questions and listening. The other interviewer – Dr. Linda Xu – took notes and occasionally would request additional information. An audio record was also made, interviewees were given an option of having an audio recording stopped or deleted at any time. The audio recordings have been, are, and will remain confidential and anonymous. A combination of face-to-face, audio remote and audio/visual remote interviews were conducted based on what was convenient and preferable for the interviewees.

The interview process has passed the point of saturation. Consequently, there has been no consideration regarding the collection of further data. In other words, the last three interviews provided no insights that were either contradictory or new. Their content provided confirmation of statements, perceptions and relationships that had been made by other interviewees earlier on in the data collection process. Hence, any additional interviews are highly unlikely to offer contradictions and/or new insights. In qualitative research, saturation is the point at which data collection can be terminated without concern regarding the possible introduction of bias.

Financial Issues

While the effect of a devaluation and continued volatility of the pound sterling is easy to recognize in terms of price inflation on imports and domestic products that consist largely of commodities that trade in US\$ such as oil and metals, there are other less obvious financial impacts.

From yahoo finance (<https://uk.finance.yahoo.com/quote/GBPEUR%3DX?p=GBPEUR%3DX>), the data below shows the depreciation of GBP overnight after Brexit vote. According to the interview, some companies lost from £10,000 to more than £100,000 within 24 hours. Since the government is unclear about a Post Brexit deal, the risk of currency volatility and depreciation remains.



Figure 1: GBP to USD currency rate history from 1st March 2016 to 14th June 2018



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The Bank of England stepped in shortly after Brexit and injected liquidity £445 billion (Quantitative Easing Asset Purchase Programme £435 billion and Corporate Bond purchases £10 billion) into the market by creating electronic money – a process known as quantitative easing (Bank of England <https://www.bankofengland.co.uk/monetary-policy/quantitative-easing>). While these funds undoubtedly stabilized assets such as house prices, the creation of electronic money reduces the value of actual money resulting, increasing price inflation and currency devaluation simultaneously. Unless social housing providers were given an increase in annual budget as a quantitative easing bonus, the real value of their budget was decreased although the nominal value appeared stable. The decreased value of the budget coupled with increased volatility in the marketplace makes managing the maintenance and upgrade of social housing units much more challenging.

These challenges may have been partially offset by a tightening of credit and a perception of increased risk resulting in a decrease in home building. Prior to the Brexit vote the new build sector was much more active. After June 2016 housing starts declined substantially. The result has been a decrease in shortages of construction labor and construction materials. In fact, the roofing tile inventories were recently at their highest levels in memory. In 2016, builders were faced with delays due to high levels of backorders. Softening of some construction markets has resulted in large customers retaining some market power as manufacturers attempt to keep market share and move excess inventory.

A tightening of credit has already been mentioned across the supply chain. During the financial crisis suppliers lost large amounts of money on bad debts, consequently there is a high level of caution regarding financial exposure. This caution undoubtedly has assisted many firms weather the impact of the Carillion failure. The experience is also helping firms protect themselves from the potential dangers with Brexit related volatility. This caution is advantageous to the social housing sector as providers of social housing are seen as being a low credit risk. Because social housing providers tend to purchase low margin products, suppliers generally see the social housing sector as an important part of their customer portfolio – the low risk low return part (equivalent to investors including government bonds in their portfolio).

The perception of increased risk results in an expectation that greater levels of equity are provided by investors and anticipated returns (profits) are higher due to compensate for the higher levels of risk. This relationship is likely to put greater pressure on UK firms with foreign ownership. It is also likely to depress foreign investment into UK manufacturers, inventory holdings and construction in the short to medium term (Eversheds_Sutherland 2017). This offers opportunity for manufacturers and investors that are domestic. However, it is likely to lead to an imbalance and tight capacity in the medium term

Materials

Many of the products utilized in building, maintenance and operations of social housing is imported or contains imported content. Much of this content is sourced from European Union members. Although there are products that are sources elsewhere – examples, include: radiator castings – Turkey, sanitary wear – China, and wood shingles – Canada.

The UK has manufacturing capacity for a wide range of products. This capacity services domestic, European and international markets. In some cases, firms utilize a model in which facilities in different countries provide different product lines. In other cases, production capacity focuses upon the UK market but may involve parts or partial assembly in other European countries. The tremendous integration of UK manufacturing capacity into the EU for both domestic and export products provides a tremendous challenge if there is a change in either access to the customs union or rules relating to the management of imports and exports.

Raw material prices are impacted by Brexit both directly and indirectly. Commodities are not only subject to price volatility based on changes in the supply and demand, but also due to trading in a specific currency – the US\$. Increased volatility in the Pound heightens the risk

associated with already volatile currency costs. One participant described how a large purchase of metals that had the unfortunate timing of being placed just before the Brexit vote and executed just after the Brexit vote resulted in a loss of hundreds of thousands of pounds on a single transaction. While it is possible to benefit from raw material price volatility – as well as lose – the existence of the volatility is a substantial complication to conducting business and adds additional cost onto transactions whether one self-insures or insures externally using commodity and currency futures.

As any British manufacturers of construction products are part of a European consortia the prices that they trade in for purchasing intermediate and finished goods and booking sales and profit are reported in Euros. Consequently, volatility in the pound impacts all transactions that are not occurring in the UK as all transfers involving EU and non-EU based products are traded in Euros for internal accounting purposes.

Supply chain members in social housing are typically carrying between 30 and 60 days of inventory. While this level of inventory is perceived to provide just-in-time service to the sector, it is very high compared to many other industries. In fact, levels as high as 6 months were reported. Carrying so much inventory is extremely expensive. If Brexit proceeds smoothly, this inventory level is much higher than it should be. If Brexit is chaotic, this level of inventory will be insufficient (Shipman 2018) and one should expect delays due to material/product shortages and purchasers paying a premium for faster delivery. As appropriate levels of inventory for materials is closely associated to the timely delivery of product, logistics is now considered.

Logistics

Changes in border controls and customs procedures are problematic as firms would need to gain expertise in customs clearing – a managerial capability that many supply chain partners do not currently possess. There would inevitably be teething problems as new systems, border controls, customs officers and customs clearing agents all had to rapidly move from a total lack of experience to a fully functioning system. Suggestions of a technology solution would be hampered by rates of adoption, scalability and inevitable changes to integrate the existing systems and the technology to each other. One likely outcome is product rationalization as firms attempt to simplify their businesses by reducing the variety of products available in the UK. Another outcome is increases in price to pay for the variable costs associated with the new customs processing requirements and to offset the one-off costs of the supporting infrastructure and training.

The presence or perception of shortages, complexity of importing, and increase in tariffs can result in a loss in markets as European firms reduce risk by excluding UK based firms and operations from consideration for new products or replace them as a contingency to reduce overall business risk (Chu 2018, Merrick 2018). As many manufacturing supply chains operate on a just in time basis an average delay of even a few minutes is sufficient to create shortages of parts and shut down factories within and outside the UK. Such concerns for European firms is very real, currently a truck arriving in the UK departs the port with almost no delay unless it is delayed for inspection a rare event for truck originating in the EU. However if European

shipments were treated the same as shipments from other countries, delays would be much more common and create delays ranging from hours to days (Castle 2018). Resulting in either factory shut downs or a need to carry substantial inventory to offset this possibility (Shipman 2018).

Such a realignment does open up the possibility for UK-based organizations to reenter domestic markets that they are not currently competing in – import substitution. When import substitution is used as a strategy to building global competitiveness in a domestic industry – the post war strategy of Japan and South Korea it can create tremendous economic opportunity. However, import substitution can result in low quality, low volume, low variety domestic production that can exist only due to the presence of protective domestic barriers to trade. This concern is often used to describe the Brazilian economy. However since the imposition of trade barriers against European food products in Russia, the quality of domestic dairy products such as cheese have notably increased. The potential for entry into new international markets is not apparent as trade deals typically take many years (decade or more) to negotiate and fully implement. Finally, there are concerns that trade between Ireland and the UK will be greatly impacted with some firms developing contingency plans to remove the management of Irish operations from UK offices.

It is important to note that not only will trade flows of materials between the UK and European Union be impacted, but also trade between the UK and other parts of the world due to the structure of ports and shipping routes. Much of the product imported from outside of Europe first arrives in a major European port and then is transferred to much smaller ships for delivery to the appropriate port in the UK. The largest container ships 20,000 TEUs can only travel between a very small number of ports. These shipping routes are very stable and established. Consequently, Liverpool's port upgrades to allow 14,000 TEU ships to unload is currently under capacity as shipping firms are reluctant to divert their existing fleet from well-established routes. Hence, the importation of non-European goods are often impacted by the *Rotterdam Effect* – the tendency for product to arrive in Rotterdam and undergo customs clearance there before being loaded onto a smaller vessel. To eliminate the *Rotterdam Effect* and make the UK ports non-reliant on European ports in a post-Brexit economy, shipping firms would have to reroute their ships and perhaps use much smaller ships that could unload in the existing UK ports. Such a requirement would not only increase the cost of shipping, but require larger inventories to be held in the UK due to less frequent international deliveries. There would also be a change in the delivery points of product requiring a change in the capacity of motorways and the roads servicing the ports.

In summary, the challenges to materials in a post-Brexit scenario relates to the close integration of supply chains, transportation and transportation infrastructure. The likely result is a need to carry much larger inventories to provide service, a decrease in product variety and an increase in shipping costs. In the short to medium terms supply chain members should expect to be exposed to logistics challenges. This can be partially offset through better planning and information sharing by social housing providers.

People

There has already been a great deal of discussion on the role that EU citizens play in a various sectors of the UK economy (Chapman 2018). The dependence on EU labor varies greatly across

sector and the associated skill levels also vary greatly. EU citizens are major contributors to the Social Housing supply chain sectors. Most notably EU-originating workers make a critical contribution for work that involves mobility. British citizens are much less likely to travel long distances, relocate temporarily, or relocate permanently for work. However, many of the EU citizens engaged in the social housing structure are prepared to *follow the work*. In the absence of such a migrant work force, local shortages will create delays and substantial wage variability across the UK for new build.

Social housing supply chain members reported low participation levels of EU citizens in administration, manufacturing, sales and professional services. A removal or even a departure of this labor force while inconvenient would not be problematic. However, in certain trades such as bricklaying and roofing and in certain locations such as London and the south, EU citizens are a substantial part of the workforce and need to be replaced if they cease to be part of the work force mix. This challenge is even greater as non-British EU citizens tend to be younger with a substantial part of the British-born workforce in trades such as bricklaying nearing retirement. Buoyancy in wages associated with labor shortages has already been noted. The reasons provided are:

- (1) An increase in trades salaries in countries such as Poland in response to the migration of large numbers of workers to higher wage countries such as the UK resulting in lower incentives to relocate from one's home country.
- (2) A weak pound making the appeal of the UK lower.
- (3) Uncertainty about status and prospects in the UK for workers who are EU citizens, but not British.

A combination of the demographics of the UK trades workforce and a reliance on other countries to train construction workers for plying their trades in the UK, complicates the challenge further as there is insufficient training capabilities and capacity to replace EU workers with British workers even if the needed British apprentices can be identified. The increasing lack of a suitable and sustainable construction workforce in specific fields is of great concern as a shortage in only one trade can prevent projects from being completed and for that matter started. In the private sector, shortage of trades will result in an increase in salaries especially for work done on an urgent as required basis. Such a prospect is alarming for the social housing sector as one cannot pass additional costs on to the end customer. There are different possible solutions to this challenge including changes in materials, practices and technology. While UK residents are described by the supply chain and sector as being traditional in tastes, the disruptions associated to Brexit could easily force individuals and providers to reassess options and the value associated with different (non-traditional) options. These possibilities are touched on later in this report.

There is also the possibility of indirect labor shortages impacting the social housing sector. As the EU-member originating workforce is no longer replenished in the UK, there will be more competition for employees of British origin. Consequently, there is a possibility of increased turnover as organizations seek individuals from other sectors to fill their employment needs. This tendency should also put upward pressure on salaries both in sectors directly and indirectly impacted by a reduction in labor force availability post-Brexit.

A tremendous amount of management attention is being utilized to address the uncertainty and potential dynamics of Brexit. As Brexit is not only urgent but a process that will unfold over many years, analysts and managers have their attention diverted from important activities and decisions they would be able to focus on in the absence of Brexit.

Information

As many supply chains are highly integrated and there are EU regulations in place to protect the flow and privacy of information between member countries and countries that are not part of the union, supply chain members were asked about the possible impact that Brexit could have on information flow and sharing of information along the supply chain.

The consistent response is that information sharing does not occur in the supply chain and cooperation is seen as being quite limited. Supply chain members indicate that interactions with purchasing organizations are helpful as it helps provide some insight into the concerns and directions that social housing organizations are likely to pursue.

A number of firms expressed frustration in the tendency to be informed of requirements with very little warning. These organizations try to support customers by carrying sufficient inventory to take into account reasonable levels of variability. In some cases, special interventions are made to ensure that customers can proceed with plans – such as making direct requests to a factory or having stock quickly shipped between regional depots. These sorts of interventions are expensive and disrupting, but are considered to be part of the service offering that the firms provide for valued customers.

It was indicated that one challenge is that during times of high demand a customer will go and place orders with multiple suppliers to see who can deliver first. Once delivery occurs all other orders are cancelled. While this sort of tactic may seem sensible to a firm that is under time pressure to satisfy their customers, it is a very damaging practice as it leads to a condition known as the bullwhip effect (Lee, Padmanabhan et al. 1997). Such an event occurred post Brexit with roof tiles. Due to exceptionally high customer demand all manufacturers ramped up production. As orders were filled it became apparent that demand had been greatly overstated. Inventory levels were described as being *higher than I have ever seen before*. These sorts of situations create excessive storage challenges, inventory expenses, idling of workers and facilities, and cash flow challenges. The costs eventually find their way to the customer either through increased prices to cover the additional costs and eventually an unwillingness to respond to customer requests for higher production level due to declining levels of trust. If the flow of information improves, the expensive bullwhip effect can be lessened. While information sharing and cooperation are not a function of Brexit, it is advisable that the sector consider the opportunities that closer coordination and integration can offer. Not only will integration reduce supply chain costs, but will assist suppliers in providing the correct product to the correct location at exactly the time it is required. Such a change can reduce time and costs associated with construction, maintenance and operations.

If current practices continue and Brexit does result in delays and disruptions in fulfilling orders, the extent of delays and losses associated with the Bullwhip effect will increase greatly. Customers that are accustomed to having supplier support staff smooth out the occasional urgent demand will find that the suppliers are overwhelmed by customer expectations and not only are they unable to accommodate requests for faster than normal service, but are hard pressed to meet regular service targets. Developing information sharing practices such as dynamically adjusted forecasting expectations could provide cost reductions while providing better service regardless of Brexit. A failure to do so will undoubtedly result in supply problems that could have easily been avoided. Activities such as this can be championed and driven by different stakeholders.

Infrastructure

Brexit will require the development of new infrastructure. All functions that have been outsourced to the European Union to a large part will need to be duplicated within the UK. Border controls relating to customs controls of products originating in the EU. In addition, products that are originating in other countries, but arriving at an EU port prior to arrival in the UK. The lack of customs control facilities needs to be addressed to avoid the presence of line-ups extending for many miles (Castle 2018) . A reconfiguration of port infrastructure and domestic transit infrastructure will also be required. This is likely to require changes to Federal budget projections for the next five to ten years as funds will need to be diverted into building the appropriate infrastructure that does not currently exist.

In addition to physical infrastructure, a knowledge infrastructure will need to be developed in many areas as importation of skills will become more challenging and the UK will have to increasingly rely on an ability to upgrade the skills or residents and citizens, as opposed to hiring-in from the large EU labor force.

Technology

Technological innovation involves the integration of new things into the existing systems to provide a new combination of costs and benefits. This can involve changes in the manner in which new construction, operation, maintenance or the processes that support one or more of these functions is accomplished.

In addition to technology, innovation can take different forms, such as: business model innovation, administrative innovation, and organizational innovation.

A high demand for housing coupled with declining availability of specific trades and a need to better coordinate activities within the supply chain throughout construction and the entire life of a home creates needs that can be at least partially filled by the appropriate application of technology. As Brexit calls for a reassessment of a business-as-usual approach and assistance is available through industrial (UK_GOVERNMENT 2017) and digitization (UK_GOVERNMENT 2017) strategy should be considered. For example, the combination of inexpensive sensors and mobile telephony can provide increased service levels through

automatic monitoring and remote diagnostic reporting on building systems. Off-site construction could not only speed up and reduce the cost of home building, but partially address the growing challenge of a shortage of workers in specific trades. It would also reduce the need for a migrant workforce. Instead transferring construction jobs to locations that have a substantial and suitable workforce available.

Technology must be considered from a systems perspective to avoid investments in infrastructure that are not desired. This requires consideration and development of many factors, such as: technical, economic, functional, perceived value, esthetics and sustainability.

Sector versus Government Priorities

The Social Housing sector seeks stability and clarity. Industrial partners are looking for stability and clarity to minimize risk and uncertainty. While social housing providers seek stability and clarity due to the fixed budgets that prevent passing on extra costs to the end user. Hence, the sector would like to minimize the number of changes, their impact and the length of transition time before a new equilibrium has been obtained.

In an effort to negotiate a better deal and remain flexible the government has postponed decisions and agreements resulting in discussion of transition periods and assurances of a step-wise transition that is fit for purpose. While such a position is logical for the government to take, in other circumstances (such as phase out of ozone depleting chemicals) industry has tried to move ahead of government expectations to move through transition periods as quickly and inexpensively as possible. This difference in perspective between government and sectors behavior is to be expected and is inevitable when there are significant changes in policy.

Possible Unanticipated Impacts

While there are many substantial direct impacts and obvious indirect impacts that are likely and attributable to Brexit, we must also be wary of unanticipated impacts. Perhaps the first unanticipated impact of Brexit on the labor force was that a reduction in low skilled migrant workers disrupted the abilities of British farms to harvest crops. A similar, but different occurrence happened in the United States some decades ago during the development and introduction of automated tomato picking equipment (Hightower 1972). Not only were the migrants displaced, but the technology resulted in the restructuring of tomato farming rendering family farms uncompetitive and ushering in an era of large corporate farms.

What is critical to recognize that it is likely that there are many unanticipated side effects that have already been set in motion. Additional unanticipated side effects that will undoubtedly arise from well-meaning policy or regulation decisions. These challenges occur even at the best of times (Pressman 1973). At a time when many decisions will need to be made quickly, it is likely that even more unanticipated impacts will occur. There is an opportunity for sector plan development to act as partial protection from unanticipated side effects by providing

stakeholders a voice in the process. Techniques such as foresight and scenario analysis can be applied for this purpose.

Race from the Bottom Effect

While there is much discussion of countries and sectors involved in a race to the bottom. In a Britain that has more control over internal policy and labor markets accompanied by a loss of the benefits associated to the European Union without extricating itself from many of the costs and disadvantages, an increase in many costs are likely. While there is the possibility of savings through importation from low cost producing countries in the far east, it will take time to develop relationships and the skills to ensure that products are made to our expectations of quality. One should expect that low cost will increasingly mean low availability.

Faced with a much smaller labour pool, the value of skills will increase leading to gradual wage increases for many accompanied by increasing levels of automation. Not only will costs be higher, but a greater premium on time should be anticipated. In such an environment, the emphasis will increasingly move from initial price to best life cycle cost. Lifecycle cost focuses on value as a function of price, timeliness, durability and quality. This trend will fit well with predictive maintenance and dynamic monitoring. It will also lead to changes in the nature of supply and demand as lifecycle approaches support different funding models (servitization) and switching barriers (Neely 2009).

Reframing strategy and operations for a post-Brexit Britain

The challenge is that Social Housing supply chains (and British industry) in general is highly integrated to and with European Union partners. Due to the current ambiguity on the nature of change of the myriad of relationships, European supply chain partners are attempting to minimize their risk by moving away from UK-based interactions (Merrick 2018). Discussions of transition periods and backstops increase the duration of the ambiguity maintaining the uncertainty. The result is that UK interaction must offer a higher expected return to make up for this risk. Until after Brexit has been completely completed, UK based organizations will not be able to access the potential benefit of future trade relations or control over local regulations. Consequently, supply chains need to focus on system optimization to remove the inefficiencies that could be ignored in the past because business as usual was sufficiently profitable.

Opportunities and Risk Reduction

The future opportunities that are offered by Brexit are unclear. However, there are a variety of opportunities that are available to reduce risk and provide benefit.

1. Professional Purchasing – The use of professional purchasing services, electronic transfer of funds, customs clearing capabilities for use post-Brexit.
2. Revisit Inventory Policy – Currency devaluations tend to lead to price increases 3-6 months later, inventory carrying costs to be avoided where possible, improve information

flows regarding customer needs for dynamic forecasting to be shared upstream in the supply chain.

3. Rethinking of Supply Chain Structure – Will changes to the supply chain structure allow for savings through inventory pooling, postponement or other changes? Are there opportunities to provide services rather than products, are there opportunities to provide customer value through risk reduction or any other non-price based benefit.
4. Consider Alternative Processes – Do alternative processes offer: greater flexibility, decreased costs, greater value? Focus on customer value and consider process mapping as a technique to identify waste, failure points and gaps in satisfaction of customer requirements.
5. New technologies – Alternative materials, off-site construction, advanced manufacturing, and digitization could all play roles in addressing many of the concerns that exist in not only a post Brexit environment, but in the housing sector more generally. The potential benefits and drawbacks should be carefully identified, tested and demonstrated. The current funding environment (Innovate UK) is very encouraging for these sort of activities.
6. Sector plan – Industrial strategy and digitization both offer opportunities for sectors. Social housing should ensure that it receives the recognition and benefit that involvement that the development of a sector plan can offer.
7. Input on Regulatory Change – One of the benefits of Brexit is local control and tailoring of regulations to make regulations more fit-for-purpose. However, during the interviews supply chain members and sector stakeholders did not identify much in terms of regulations that needed to be added, modified or eliminated. The main discussion relating to regulatory change was how the planning approval process is a significant barrier.
8. Promotion of Housing Development – Development of housing involves both increasing enablers and removal of barriers. Concerns were expressed that short to medium duration programs to encourage energy efficiency or other forms of behavior are not structured to result in sustainable changes in behavior. In fact, the presence of urgency driven by limited term programs or other factors can result in a strain on the existing delivery systems resulting in increased prices and workmanship of lower quality.
9. New Training Model – Even without post-Brexit immigration controls increasing salary levels in low wage EU member states coupled with a declining pound will increasingly require the UK to train more construction trades people. The additional capacity could be reduced if new technology and/or materials and/or building techniques are adopted (item 5 above).
10. New Career Model – Increasing complexity in relation to advances in technology and management of uncertainty calls for an increased professionalism in many activities associated to the social housing sector. Identification and inventory of appropriate skills should be undertaken. From this continuing education and apprenticeship programs should be considered to raise the skill levels and job satisfaction of employees as well as help clarify what career pathways are available within the sector.

Supply Chain **Disintegration** Versus **Integration**

As the comment has been made by most interviewees that coordination and information sharing along the supply chain is very limited, it can be argued that the supply chains that support Social Housing have low levels of integration. However, from the perspective of traditional relationships between vendor and customer the relationships are very stable. Brexit as an event provides challenges that can at least be partially addressed through consideration of both integration and disintegration of existing relationships.

Integration is the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organizational processes, in order to achieve effective and efficient flows of products and services, information, money and decisions, to provide maximum value to the customer (Flynn, Huo et al. 2010).

Disintegration is the re-alignment of partners and coordination within a supply chain to enhance customer value. This involves one of more the following: the integration of new suppliers, the elimination of existing suppliers, the transfer or addition of responsibilities and/or value added-activities amongst the members of the supply chain. This process is driven by one of more of the following: introduction of new technology or input, elimination of existing technology or input, change in customer requirements, and/or change in other external factor – such as regulations or policies (Linton, 2018).

The Social Housing supply chain in its current form appears far from optimal, due to lack of information sharing, coordination and stability of existing practices and relationships. The shock of Brexit will place more stress on this system potentially to the point of unsustainability to some of its members. Since the Brexit vote some supply chain members have modified practice and in the process improved their own operations locally. It is suggested that serious consideration should be taken across the supply chain to optimize for better overall performance. In supply chain management performance is based on the provision of customer needs in the most efficient and effective way possible.

From the perspective of integration, improving supply chain performance will involve:

1. Information sharing to reduce the amount of inventory and work-in-process in the system.
2. Coordination to reduce time and cost, reevaluation of current processes and practices to remove activities that do not provide value.
3. Modification of tasks to provide greater value.
4. Moving tasks to a different supply chain partner who can provide better value due to their position in the supply chain.
5. Moving tasks to a different supply chain partner who can provide better value due or their internal capabilities and skills.

The skill sets that support these activities are process mapping (Shostack 1984, Linton 2003) and consideration of postponement versus speculation (Manuj, Esper et al. 2014).

From the perspective of disintegration, improving supply chain performance will involve:

1. Prepare for changes in the roles of suppliers and supply chain partners.
2. Prepare for changing suppliers.

3. Assessing technology integration opportunities and how these could impact your organization and your current suppliers.

Conclusions

In the short to medium term the existing supply chains should be optimized to reduce risk and to gain an increased understanding of their current practice. As the dynamics of Brexit decline and a future stable system is approached it will be easier to adapt the existing supply chains appropriately. The magnitude of Brexit is too large for a strategy of muddling through with incremental change to be sufficient. Hence, the recommendation to revisit and optimize existing practices and processes.

While Brexit provides many risks and challenges, it also offers opportunities. There are many problems within the housing sector (UK_GOVERNMENT 2017), Brexit offers an urgency that in combination with the Industrial Strategy (UK_GOVERNMENT 2017) can lead to a transformation of the sector over the next decade. To achieve this a systems approach is required to simultaneously take into account: finance, materials, logistics, people, technology, infrastructure, regulation and policy.

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