Managing service infrastructures in shrinking cities: challenges and opportunities
Excerpt from: Future Directions for the European Shrinking City (2016),
Chapter 11, Jörg Walther

Introduction

Technical infrastructures are central to the development of cities and in the case of European urban settlements these infrastructures are characterised by service networks that are centrally organised. We hardly notice the technical infrastructures which provide energy, communications and transport, ensure fresh drinking water and the safe discharge of wastewater and rainwater. While the centralised design and management of such utility services ensures economies of scale and high standards, there are also some fundamental disadvantages which come to the fore when cities are shrinking. The first is that service infrastructures require long-term capital investments, large elements of which are fees and prices that are fixed over long periods of time. The second key challenge is that service plants have a life span of 30–50 years, with supply networks lasting for more than 100 years (Koziol and Freudenberg, 2003; DV, 2007). Hence the upfront investments in supply networks are very high while the scope to adapt to changes, such as reductions in demand, is limited (Koziol *et al.*, 2006a).

Shrinking cities encounter particular challenges in this regard because they have limited options to raise capital and there is also very limited scope to increase the number of residents or industries to levels which would ensure minimum levels of utilisation. This raises a number of questions in regard to service infrastructures in shrinking cities, including:

- Which technical problems can be expected and how should they be evaluated?
- Which economic effects can be expected?
- How do those effects impact prices and fees?
- What are the solutions and alternatives for dealing with infrastructure in shrinking cities?

Technical problems of central service infrastructures

Service infrastructures are subject to a range of challenges, some arising from reductions in the size of service networks and others from a reduction in consumption. Infrastructures that are particularly prone to serious technical problems as a result of low utilisation levels are water, wastewater and heating related service infrastructures. In some cases low levels of utilisation are rooted in designs that were based on anticipated consumption levels which did not occur in practice. For example, between 1990 and 2000 the drinking water consumption per head in eastern Germany was reduced by 50 per cent which resulted in water related service infrastructures across the country that now have too much capacity (Koziol, 2001). Areas suffering from urban shrinkage show particularly problematic developments in relation to the supply of drinking water and the management of sewerage because the minimum level of utilisation required for the efficient operation of such systems is not reached.

This includes exceeding the recommended flow times of five days from drinking water generation to consumption. In Magdeburg, for example, flow times of up to 30 days were measured which reduces water quality and breaches technical guidelines for bacterial content and potential for contamination (Korth and Wricke, 2003). In addition, such slow flow times lead to increased deposits in supply pipes, requiring more frequent maintenance.

In parallel the quantity and composition of wastewater reduces. The wastewater flows slower, deposits build up and blockages occur. Incidents of sewage decomposing in pipes are on the increase in cities affected by shrinkage, resulting in bad odours and corrosion which can lead to pipe rupture, particularly with older sewerage systems (Koziol and Walther, 2001). These problems can be addressed through increased servicing, pipe washing and the application of chemicals (Koziol, 2005). However, in the long term the effective functioning of water related infrastructures can only be achieved through structural adjustment or in some cases the complete replacement of such service networks. As high costs are a barrier to adjustment and replacement, municipalities and service providers tend to continue using oversized and underutilised networks instead of taking proactive steps to manage their reduction (Erdmann, 2007).

For example, cities in the former East Germany with a vacancy rate higher than 30 per cent in residential property tend to encounter problems with water supply, sewerage and also district heating systems (Koziol and Walther, 2001). Hence we can expect that many cities will have to invest in the management or reduction of service oriented infrastructure in the medium term.

While telecommunications and electricity networks as well as roads are relatively flexible in adjusting to decreases in demand, water-based service infrastructures, including district heating systems running on hot steam, are much less flexible and require substantial investment when demand drops below a minimum level.

Which economic effects are expected?

Regardless of vacancy levels, local authorities have the duty to supply residents and businesses with water, energy and a sewerage system. Furthermore, underused networks must be operated in areas of the city where the vacancy rate far exceeds 30 per cent. The operational measures, such as flushing or the use of chemicals, lead to additional operating costs and additional capital costs arise through replacement of machinery or pipes in the supply networks (Koziol and Freudenberg, 2004).

There is little research which assesses the scale of the cost increases arising from additional maintenance due to underutilisation. This is in part because such costs are usually not separately captured in the companies' accounts as 'shrinking-related operating costs'. Current research by the Brandenburg University of Technology has developed a model to estimate such costs (Koziol and Walther, 2006).

Based on an assumed vacancy rate of 50 per cent the following additional costs arise for drinking water, sewerage and district heating systems (Siedentop *et al*., 2006):

- Drinking water operating costs increase by 10 per cent.
- For wastewater, operating as well as capital costs increase. An increase of 35 per cent for operating costs and 12 per cent for capital costs can be expected.
- For district heating an increase of 7 per cent in operating costs is expected.

These general figures need to be considered as indicative because operating as well as capital costs rise disproportionately to increasing vacancy and can reach levels well above this model calculation. The lower the demand, the higher the increase in the cost of managing further decline in demand. For agencies responsible for these services this means having to adapt to rising absolute costs in shrinking cities. This is because the cost increases in the affected areas of the network will lead to overall increases, despite the fact that districts with low vacancy rates will have stable cost profiles.

Additional capital costs arise as a result of the demolition of a building, when supply lines are interrupted or have to be rebuilt to keep the remaining parts of the network connected. This is a particular problem in the case of prefabricated buildings where the supply lines do not follow street networks but run through the basements of buildings, connecting one with another. However, connection costs can be avoided if whole areas are demolished and disconnected from the service network.

Not only do additional costs have to be accommodated, the ratio of costs to the quantity of water and heat supplied or sewerage removed changes significantly. While supply costs increase as populations decrease these increases are relatively modest for individual residents because operating costs make up only 15–25 per cent of the overall service infrastructure costs (Koziol and Walther, 2006; Marschke, 2006).

The diagram above illustrates that all service infrastructures are affected by cost increases, regardless of their technical flexibility and that these increases apply to capital as well as operating costs. Hence the key variable determining the development of costs is demand density (ESA, 2002; Weidner, 2005; Deilmann and Haug, 2010).

How do the economic effects impact fees and charges?

Despite the ability to model additional costs, at the moment the causal relationships between shrinkage and economic impacts on the provision of water, heating and sewerage services are difficult to measure. This has a number of reasons. For example, additional costs arising from underutilisation are buffered by zonal fee structures which allow for the apportionment of additional costs to users outside the affected areas (Marschke, 2006). Therefore, factors like the relationships between settlements in the supply network that reach beyond spatial boundaries of administrative areas of municipalities can only be determined on a case by case basis.

However, it can be assumed that with less urban density in city regions the fee and price stabilising effects of existing uniform tariffs will reduce. The resulting imbalance between standard charges and local costs may in future need to be adjusted through price and fee increases across different administrative areas.

The tools for the regulation of prices and fees exist, and as far as Germany is concerned the provision of technical service infrastructures is part and parcel of the utilities that are provided for the public. Prices and fees for utility services such as water and sewerage require agreement at a communal and political level, where decisions are based on an assessment of the impact price changes might have on social sustainability, the communal budget and also the costs for businesses and developers compared to other communities (Koziol *et al*., 2006b; Siedentop 2008).

However, competition, especially in the field of district heating, produces a tight market situation which makes it difficult for private companies to pass higher operating costs on to customers. This results in providers trying to compensate for cost increases internally which is another reason why additional costs resulting from urban shrinkage are difficult to detect. Furthermore, these pressures to accommodate rising costs in a stable price market lead to reductions in maintenance expenditure. As the requirement for maintenance work increases in proportion to the degree of underutilisation, today's cost savings are undermining the future security of supply and disposal.

Possible interventions to manage 'infrastructure compatible' shrinkage

Municipalities can take a number of actions to address the problems we have outlined so far. These include aiming to maintain existing housing and residential densities when new developments are considered. Where urban shrinkage provides options for the reuse of sites (see Ferber in chapter 10 of this volume) requirements arising from existing service infrastructure should inform strategic decisions on the most appropriate land use type. This leads to arguments that the shrinkage process demands an integrated and coordinated approach which considers interdependencies between different city areas and also between former and future land uses.

From the infrastructural point of view area-wide demolition is advantageous in terms of short- and long-term costs. Short-term costs for reconstruction and adjustments will be largely avoided while long-term costs are reduced as a result of the reduction in the area's spatial extent. In areas with apartment vacancy rates below 30 per cent selected demolition is a cost-saving alternative – in particular, where this is done with due consideration for existing service infrastructure, additional costs associated with infrastructure adjustments or reconstruction can be avoided. However, this approach is only effective where cities attempt to stabilise their populations and arrest ongoing outward migration. If this is not a feasible option it may be advisable to take drastic area-wide demolition measures.

From a service infrastructure point of view strongly shrinking areas with limited development potential might have to be abandoned completely, so that service infrastructures can be shut down and dismantled. This would support districts where shrinkage is less prevalent. These areas would need to be upgraded and incentives to attract residents from other areas of the city need to be created to reduce vacancy rates (Koziol, 2005; Moss *et al*., 2008; Tietz and Hühner, 2011; AGFW, 2013).

Public agencies providing funding for urban renewal in Germany require integrated urban development plans for the promotion of urban and infrastructural development. The background to this was that the potential for conflicts could then be significantly reduced, particularly in terms of capital cost-intensive infrastructure (Koziol, 2008).

For many German cities the introduction of an integrated urban development plan for the whole city has proved to be helpful when dealing with the process of shrinkage. This plan brings together the aims and proposals for all city development areas, including spatial and infrastructure issues, in a common framework where options are evaluated and summarised into an integrated concept. Based on urban concepts, in a second step, many cities developed concepts for quarters affected by shrinkage and those that needed to become enhanced, in which they applied design principles down to the level of individual buildings.

Challenges associated with adjusting infrastructure

The case of Cottbus illustrates the importance of strategic analysis and choice when attempting to take an integrated approach towards adjusting service infrastructures to shrinkage. These go beyond dealing with technical problems and include social, economic and legal challenges. In the following section we provide a brief overview of some of these challenges and how they were tackled in Cottbus.

Strategies aimed at the area-wide demolition of residential housing are likely to be only viable where public agencies or social landlords own a large proportion of the housing stock.

Engaging with residents whose homes are to be demolished early on in the planning process must be a priority, but this can be difficult because residents are not given a choice as to whether or not they can stay in their homes. In Cottbus social housing agencies offered apartments of at least the same standard, but usually better, in ‘exchange’ for the apartment that was to be demolished. In addition, furniture for the new apartment was also paid for as were all costs associated with the move. The costs for these incentives were included in the financial package created to pay for the demolition of the buildings and the entire process was managed by a dedicated manager working for the municipality, to minimise disruption for tenants. However, despite these incentives a tenant community in the Cottbus district of Sandow refused to vacate their apartments. Residents had developed strong social bonds as many of the tenants had lived in their apartments for most of their adult lives. The legal framework governing the ownership of the apartment blocks did not allow their demolition without the consent of the tenants and as they fiercely resisted any attempts to be moved the battle went on for a long time. Only when local housing agencies were able to offer a large number of apartments that would accommodate the whole community in a different location was an agreement reached. Cottbus was fortunate in having a large amount of housing stock in one place available to relocate the residents.

Such situations are likely to be encountered frequently, but many cities struggle with providing a large number of apartments in one place to 'transplant' a residential community. Hence their strategic plans should include contingencies to accommodate such eventualities by building up concentrations of vacant housing stock in districts that will be protected from shrinkage. A further lesson that can be drawn from Cottbus is that all negotiations with residents must take place on a personal level. Demonstrating that public agencies can be flexible together with a financial package that allows public agencies to minimise disruption and costs for tenants also appear to be key ingredients for effective interventions.

Another challenge arises when individual property owners refuse to cooperate with the demolition strategy. Refusal to abandon their property can lead to long delays in the implementation of adjustment strategies which is illustrated by a restaurant in the district of Sachsendorf in Cottbus. Despite area demolition progressing around his restaurant the owner did not want to be relocated and insisted on remaining in the same place. This was problematic in many respects but in particular for the heat supplier because this restaurant was at the end of a long and large district heating pipe designed to provide heating for more than 1,000 apartments (Humpal *et al*., 2004). After several unsuccessful attempts to reduce the running costs the entire supply line was taken out of service and an individual heating boiler was installed in the building at the expense of the heat supplier. After two years of resistance it was the loss of customers and an increasingly desolate environment which made the restaurant owner cooperate with the municipality.

Buildings which have outstanding mortgage loans secured on them are a further source of problems. In Cottbus many recently developed apartment blocks were identified as primary targets for demolition, but banks which had their loans secured against the buildings refused to cooperate because this would have led to a loss of income from mortgage payments. Here the solution was to transfer existing mortgages from buildings earmarked for demolition to other buildings that would be maintained for the foreseeable future (Architekturwerkstatt, 2005). Only large housing companies can offer this kind of approach, but the case of Cottbus shows that debt restructuring and 'swapping' buildings facilitates demolition if the housing stock that is to be demolished is not yet fully paid for.

Similar problems can arise where public funding was used to modernise residential properties. Such improvements tend to come with a requirement that investments are protected for a certain period of time. Many grants from the European Union structural funds are subject to such conditions. Breaches of such 'locking' conditions result in owners having to repay the improvement grants they received. While demolishing a building that was recently refurbished would not be acceptable, closing it to residential or other uses on the other hand was permissible in Cottbus. As part of the infrastructure adjustment strategy some apartment blocks were vacated and then the buildings were shut down until the time period which had locked the investments had expired. This facilitated the reduction and adjustment of service infrastructure as demolition progressed in the area (Koziol, 2003).

A final point to be raised here is that long-term energy supply contracts also pose a barrier to the adjustment of service infrastructure. It is widely-used practice for housing and utilities providers to enter into long-term mutual contracts for heat supply. Because such arrangements provide long-term planning horizons and security for the supplier and the customer these contracts do not tend to cater for an early termination. Demolition in particular is not found as a potential reason for early termination in such contracts because this problem did not feature when the contracts were drawn up. In East Germany this poses problems for most cities which is the reason why the Federal Government established a framework agreement, which offers the special right of termination of energy supply where a building is identified for demolition (Schreck, 2001; Goldschmidt and Taubenek, 2003; Goldschmidt and Taubenek, 2010). Heat suppliers are compensated for the loss of income and a settlement was reached in which the city guarantees financial compensation to energy companies where the decommissioning of the energy supply forms part of the integrated development plan for the shrinking city.

References

AGFW e.V. (2004) *Analyse typischer Fallgestaltungen beim Rückbau von Fernwärmeleitungen*. Frankfurt/Main: AGFW.

AGFW e.V. (2013) *Schnittstelle Stadtentwicklung und technische Infrastrukturplanung – Ein Leitfaden von der Praxis für die Praxis*. Frankfurt: AGFW.

Architekturwerkstatt (2005) *Quartiersentwicklungskonzept.* Cottbus: Stadt Cottbus.

BauGB (2004) *Deutsches Baugesetzbuch in der Fassung der Bekanntmachung vom 23. September* 2004 (BGBl. I S. 2414), Berlin: BauGB.

Cottbus (2002) *Stadtumbaukonzept.* Cottbus: Stadt Cottbus.

Cottbus (2006) *Teilräumliches Konzept für den Stadtumbau Neu-Schmellwitz*. Cottbus: Stadt Cottbus.

Cottbus (2010*) Stadtumbaustrategiekonzept Cottbus 2020–2. Fortschreibung des Stadtumbaukonzeptes als Bestandteil des Integrierten Stadtentwicklungskonzeptes (INSEK).* Cottbus: Stadt Cottbus.

Cottbus (2013) *Kommunales Energiekonzept.* Cottbus: Stadt Cottbus.

Deilmann, C. and Haug, P. (2010) *Demographischer Wandel und technische Infrastruktur: wer soll die Kosten tragen? Eine Untersuchung am Beispiel ostdeutscher Mittelstädte*. Aachen: Shaker-Verlag.

DV (Deutscher Verband für Wohnungswesen, Städtebau und Raumordnung) (2007) *Chancen der vor uns liegenden demographischen Entwicklung für die Wohnungs- und Städtepolitik*. Bonn: Fraunhofer IRB Verlag.

Erdmann, T. (2007) Stadtumbau und Infrastruktur – technische, investive und bilanzielle Aspekte aus Sicht eines Kommunalversorgers. In Schöneich, M. (ed.) *Stadt-Werke: Festschrift für Gerhard Widder*, Band 12. Frankfurt am Main: Peter Lang, Europäischer Verlag der Wissenschaften, pp. 367–385.

ESA (Energieagentur Sachsen-Anhalt) (2002) *Auswirkungen der strukturellen Veränderungen in den typischen großflächigen Plattenbau-Wohnquartieren in Sachsen-Anhalt auf die Geschäftsentwicklung der Stadtwerke bzgl. der Medienver- und -entsorgung*, Positionspapier, Magdeburg.

Goldschmidt, J. and Taubenek, O. (2003) Städtebauliche Grundlagen der Konzepte. In Hoppenberg, M. and de Witt, S. *Handbuch des öffentlichen Baurechts*. München: C. H. Beck.

Goldschmidt, J. and Taubenek, O. (2010) *Stadtumbau – Rechtsfragen, Management, Finanzierung*. München: C. H. Beck.

Humpal, H., Kultscher, M., Koziol, M., Walther, J. and Reim, K.-P. (2004) *Gutachten zu Maßnahmen der Stadttechnik und des Verkehrs beim Stadtumbaukonzept für die Gebiete Cottbus Sachsendorf-Madlow, Quartiere A, B und C*, 2. Fassung, Cottbus.

Korth, A. and Wricke, B. (2003) Veränderung der bakteriologischen Güte von Trinkwasser während der Stagnation. *Energie und Wasserpraxis* 12/2003 – DVGW Jahresrevue: 89–91.

Koziol, M. (2001) *Auswirkungen des Stadtumbaus auf die kommunale Infrastruktur, Vortrag im Rahmen der Tagung Stadtumbau : Wohnen und Leben mit Rückbau, Risiken und Chancen schrumpfender Städte,* Konferenzveröffentlichung, Frankfurt/Oder.

Koziol, M. (2003) *Stadtumbau Ost – Wie geht's noch besser?* Beitrag zur Podiumsdiskussion beim Kongress "Zwei Jahre Stadtumbau Ost", am 27. November 2003, Berlin.

Koziol, M. (2005) *Konsequenzen des Stadtumbaus für die technische Infrastruktur,* Konferenzveröffentlichung zur Fachtagung "Abwasserbilanz 2006", Wildau.

Koziol, M. (2008) Technische Infrastruktur als Orientierung für einen sparsamen Stadtumbau. In Bundesamt für Bauwesen und Raumordnung (ed.) *Stadtquartiere im Umbruch, Infrastruktur im Stadtumbau – Chancen für neue Freiräume*. Bonn: BBR.

Koziol, M. and Freudenberg, D. (2003) *Arbeitshilfe zur Anpassung der technischen Infrastruktur im Stadtumbauprozess, Fachbeiträge zu Stadtentwicklung und Wohnen im Land Brandenburg.* ISW-Schriftenreihe, Band 2–2002. Frankfurt/Oder.

Koziol, M. and Freudenberg, D. (2004) *Folgen des Stadtumbaus für die technische Infrastruktur,* Vortrag im Rahmen der Konferenz “Rückbau und Recycling von Plattenbauten” Technische Universität Cottbus, Cottbus, 2004.

Koziol, M. and Walther, J. (2001) *Folgen der Stadtumbaus für Netze der Stadttechnik und des Verkehrs.* Stadtumbaukonzept Cottbus. Cottbus: Stadt Cottbus.

Koziol, M. and Walther, J. (2005) *Rahmenbedingungen für die Rücknahme von technischer Infrastruktur.* Bundesamt für Bauwesen und Raumordnung, Bonn. Available at http://www.bbr.bund.de/BBSR/DE/Veroeffentlichungen/BBSROnline/2002_2006/Rahmenbedingungen.html?nn=413102 (accessed 1/5/2015).

Koziol, M. and Walther, J. (2006) Ökonomische Schwellenwerte bei der Rücknahme von technischer Infrastruktur in der Stadt. *Informationen zur Raumentwicklung*, Ausgabe 5/2006, Seite: 259–270.

Koziol, M., Veith, A. and Walther, J. (2006a) *Stehen wir vor einem Systemwechsel in der Wasserver- und Abwasserentsorgung? – Sektorale Randbedingungen und Optionen im stadttechnischen Transformationsprozess.* Schriftenreihe netWorks-Papers, Bd. 22, Forschungsverbund netWorks, Berlin.

Koziol, M., Veit, A. and Walther, J. (2006b) *Stadtumbau Ost – Anpassung der technischen Infrastruktur*. Schriftenreihe Werkstatt: Praxis, Heft 41, Bundesamt für Bauwesen und Raumordnung, Bonn.

Marschke, L. (2006) *Stadttechnische Infrastruktur in schrumpfenden Städten*, Ringvorlesung. Dresden: TU Dresden.

Moss, T., Naumann, M. and Wissen, M. (2008) *Infrastrukturnetze und Raumentwicklung – Zwischen Universalisierung und Differenzierung*. München: Oekom-Verlag.

Schreck, G. (2001) Konsequenzen des umfangreichen Rückbaus von Gebäuden im Plattenbau für das Fernwärmenetz. *Euroheat & Power* 12/2001: 40–47.

Siedentop, S. (2008) Infrastrukturentwicklung und Probleme der Kostenermittlung und –verteilung. In Binas, E., Kofner, S., Schulze, J., Steinert, E., Thiele, G. and Zillich, N. (eds) *Görlitzer Beiträge zu regionalen Transformationsprozessen, Band 3 – Hypertransformation*. Frankfurt am Main: Peter Lang Verlag

Siedentop, S., Schiller, G., Koziol, M., Walther, J. and Gutsche, J. M. (2006) *Siedlungsentwicklung und Infrastrukturfolgekosten – Bilanzierung und Strategieentwicklung*. In Bundesamt für Bauwesen und Raumordnung. Available at: http://www.bbsr.bund.de/BBSR/DE/Veroeffentlichungen/BBSROnline/2002_2006/ON032006.html?nn=395966 (accessed 1/5/2015).

Tietz, H.P. and Hühner, T. (2011) *Zukunftsfähige Infrastruktur und Raumentwicklung, Handlungserfordernisse für Ver- und Entsorgungssysteme*. Hannover: Verlag der ARL.

VKU (Verband kommunaler Unternehmen) (2004*) Rechtliche Bewertung der Verlegung, Anpassung und des Rückbaus von Leitungen und Anlagen der öffentlichen Ver-und Entsorgung im Rahmen des Stadtumbaus Ost*. Köln: VKU.

Weidner, S. (2005) *Stadtentwicklung unter Schrumpfungsbedingungen: Leitfaden zur Erfassung dieses veränderten Entwicklungsmodus und zum Umgang damit in der Stadtentwicklungsplanung*, Dissertation an der TU Leipzig,