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V-KEMS Report

Communities of the Future



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WARNING: this report contains preliminary findings that have not been peer reviewed. The findings are intended to provoke further study and policy discussion and should not be treated as definitive scientific advice in response to the SARS-CoV-2 epidemic.

Whilst we expect these principles to help others formulate coherent and consistent guidelines, time has prevented any quantitative study of their effectiveness. This could be undertaken, but would require real data and time to build more detailed simulation tools. Thus, we are not able to make specific recommendations from the principles, e.g. we cannot infer that it is safe to do X if you follow principle Y.

Additionally, this report has been assembled in a short time frame, we have made every effort to ensure references and links are present. Where this is not the case, we apologise for the unintentional oversight.

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1 Executive Summary

This report details the progress of a Virtual Study Group (VSG) held between V-KEMS and a group of researchers from across the UK between the 12 - 14 January 2022. Several challenges were set in context by the Department for Levelling Up, Housing & Communities, City of Edinburgh Council, and Luton Borough Council. The ultimate aim of the session was to develop approaches which could be used by local authorities to support their communities in the services they provide.

Luton Council: Section 2 outlines the discussion and progress made regarding challenges posed by Luton Borough Council. These challenges were:

1. How can Luton Airport be developed to provide work for people and increase its business. This challenge is in the context of a planned expansion from 18 million to 32 million passengers. Specifically, how can this expansion
 - Best support economic growth/jobs in Luton and work with plans for Net Zero - here the group outlines a methodology which could be used to assess, and maximise, the utility of different strategic scenarios given the potential impact on the various "agents" in Luton. Various next steps and discussion points are proposed to refine and develop the methodology.
2. Understanding the evolution of Luton as a town. This challenge is in the context of future trends and drivers which will impact Luton residents and businesses, specifically;
 - How is the use of physical premises changing in Luton? Here the group began to build a forecast model of business occupancy.
 - How do people move around Luton and how is this changing over time? Using a flow network representation parameterised by historical usage, the group discuss what impact the changes different infrastructure might have on the transport system?

City of Edinburgh Council: Section 3 outlines the discussion and progress on how modelling can be used to predict the likely impact of the following possible interventions for the City of Edinburgh Council:

1. Impact of removal of requirement of local connection. Currently in Edinburgh a household presenting as homeless must have a local connection to Edinburgh in most circumstances. This may be reviewed in the future and may result in an increase in the number

of individuals and households that the Council has a duty to house. Progress on this task involved;

- Taking numbers of current applicants
- Applying migration flows from census
- Estimating increased applications in Edinburgh

2. Impact of a proposed change to prevention duty. The Scottish Government are currently undertaking a consultation on proposals for a new prevention duty on local authorities and other agencies. The key change being proposed is an extension of the duty for a Local authority (LA) to recognise a household as being at risk of homelessness when they may lose their accommodation in 6 months instead of the current 2 month consideration. To model this, the group:

- Sketched out a dynamical system model
- This model requires further work to parameterise with data
- Model transfer terms could be adjusted to model the proposed changes.

3. Impact of court action recommencing post COVID-19 particularly for private tenants. The pandemic has had an impact on those being made homeless by a pause in court action. With this recommencing, the group is interested to understand the impact on flows through the system. Progress on this task includes:

- Finding some relevant data. Sources were found, but not in an easy to use form.
- Beginning to investigate the problem using a dynamical system model

2 Luton Borough Council

Luton Borough Council (LBC) is the local authority of Luton, England. It is a unitary authority, having the powers of a non-metropolitan county and district council combined. Luton Borough Council (LBC) have ambitious goals to be the first town to sign up to the Good Business Charter which promote good business practices in fairness, employee well-being, ethical sourcing and other criteria.

LBC face challenges in understanding how best it can support local businesses in line with the Good Business Charter, in particular to create jobs which are 'quality' highly skilled roles and which bring benefit the community. The below details two key challenges addressed during the VSG;

1. The impact of the airport on economic growth in Luton in the context of proposed growth from 18 million to 32 million people. How can this expansion (a) best support economic growth/jobs in Luton and (b) work with plans for Net Zero.
2. Understanding the evolution of Luton as a town by exploring (a) how is the use of physical premises changing in Luton? (b) How do people move around Luton and how is this changing over time? and (c) what impact will the changes have on the need for different infrastructure, particularly the transport system?

Major disrupters which will affect the future development of LBC



- Changes to transport system
- Potential reduction in air travel



- Less travel to workplaces and retail



- Massive change to the transport network



- Changing the way goods are transported over long distances

2.1 How can the airport be developed to provide work for people and increase its business?



About the airport:

- Luton Council owned, and enormously impacted by COVID-19
- UK's 5th largest airport with 18 million passengers prior to the pandemic. Plan to expand to servicing 32 million passengers
- New Century Park is part of the London Luton Airport Enterprise Zone, supported by SEMLEP, which will deliver up to 7,200 new jobs and inward investment to support economic growth across the sub-region
- Bartlett Square is a 2.5 acres of commercial development off Kimpton Road, next to Luton Airport Parkway station and the proposed Luton Direct Air-Rail Transit (Luton DART) scheme
- Morton House is a new skills, innovation and business hub to create 200 jobs for Luton
- Most people are just passing through, but the Town Centre is only 3 miles away

The primary aim of this section is to explore if it is possible **to improve the 'wealth' of Luton town by taking different actions**. The total "wealth" of the town comprises a number of different "agents", each with their own positive and negative drivers. The agents considered in this VSG are summarised below.

Agent	Positive drivers	Negative	Challenge
Passenger	Short time at airport, low budget flights, DART from London	Border control queue, car parking costs, shops after security, lack of airport facilities, restaurant opening hours, nothing nice close to the airport, very early flights, connections lead to an overnight stay	Proximity of Heathrow
Airport	Car parking, long time at airport, rental income, shops after security, private jets	Resident concerns, Expensive parking, People packed, unprofessional check-in staff, no shops open after 9pm	Zero carbon, double in size, more qualified staff, more shops open in the evening
EasyJet	Low-cost airline, early flights, monopoly, bespoke destinations	Resident concerns, private jets, unhelpful staff	Zero carbon, more connecting flights
Luton council	Green incentives, local jobs, hotel use, local vendors at airport, Uber, Easy Jet hub	few hotels close to airport, passengers shop after security, resident concerns	Zero carbon
Local Vendors	ECO friendly, good links to town centre	Shops after security, costly rental	
Travel providers	Uber, local buses, DART to Parkway station, then trains to London, electrical vehicle charging points	Cost of parking, no facilities for staff	

The aim is to assess the utility, U , of three different strategic scenarios described later. Three different types of utility are considered (a) economic benefit, (b) jobs, and (c) environmental benefit. The overall utility is then computed as a weighted sum: $U = \sum_{k=1}^3 U_k$, where

$$U_k = \sum_{\text{agents}} \text{importance}_{\text{agent}} \text{weight}_k$$

The strategic scenarios considered are:

Scenario 1: Doubling size of the Airport

Scenario 2: Optimize travel and waiting time at the airport

Scenario 3: Net Zero carbon Emission

Scenario 1 - Doubling size of the Airport

This airport business plan aims to increase the ‘before-security’ shop provision. There are many more shops in the ‘after-security’ area, which is only accessed by the few passengers departing from the airport, below.



Figure 1: (Left) before security. (Right) After security.

The passengers in the ‘after-security’ area of the airport might take another flight to another UK city or another country, so it is likely that they are international travellers, who tend to prefer popular shop chains to local shops. The economy of Luton does not benefit from the purchases in this area, so the enlargement of the airport must be focused on the ‘before-security’ area.

Concerning the typology of shops that can be set up in the airport, we notice that the top-rated ones are close to the train station. As the Uber service is gaining increasing popularity, we think that is reasonable to expose travellers to those shops inside the airport.

Utility table: Below in the top row is the weight given to each agent for this and the other scenarios, we have given highest priority to Luton Council, then airport, then passengers etc. Then one can see the score [-1, 0 , 1] for each aspect relating to negative, neutral and positive impact respectively.

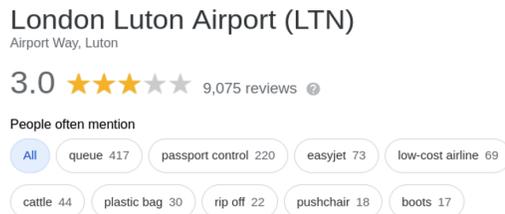
	6	7	5	8	4	4	
Scenario 1	Passenger	Airport	EasyJet	Luton Council	Local vendors	Travel providers	Overall utility
Economic benefit	-1	1	1	1	1	1	
Jobs	0	1	1	1	1	1	
Environmental benefit	-1	-1	-1	-1	-1	-1	
Total	-2	1	1	1	1	1	3

Next steps

- To consider this scenario in more detail, we need to know what is the area in the airport that will be increased, is this still to be agreed with the council?
- To have an average count to and from the airport to better understand the best action to take about the position of the shops.

Scenario 2 - Optimise travel and waiting time at the airport

This scenario gives priority to the experience of travellers. Given the bad reviews of the airport we think that an improvement of the connections within Luton and the high-quality of the staff can impact positively on the reputation of the airport, with a consequent economic gain.



The following actions can help achieve this goal:

- Investment on the **public transportation plan**, through an increment of bus lines and pooled car sharing.
- Increment of **qualified staff within the airport** in order to avoid complaints: The staff should be allocated in areas where more passengers are packed and be available to deal with possible complaints related to waiting time, boarding delay, temporary absence of some services.
- **Curb-side bag drops.** This service and the online check-in avoids security control inside the airport. Passengers can move more easily within the airport without carrying any luggage.
- **Car valet service.** This service supports the local employment and is targeted at people leaving for a long-term period. This way, there will be always parking lots available for the other travellers.

Utility table

Scenario 2	Passenger	Airport	EasyJet	Luton Council	Local vendors	Travel providers	Overall utility
Economic benefit	1	1	1	1	1	-1	
Jobs	0	1	1	1	1	-1	
Environmental benefit	-1	-1	-1	-1	0	-1	
Total	0	1	1	1	2	-3	2

Next steps

- Conduct a survey inside the airport to obtain up-to-date feedback
- Qualified staff needs a proper education to deal with passengers from different Nationalities. If the recruitment occurs in Luton, schools and universities must invest for this type of role
- What is the percentage of people that arrive at the airport with private vehicles and with public transport? Based on this data, Luton can decide to invest more on the amplification of the Parking area or on the number of public routes heading to the airport

Scenario 3 - Net Zero carbon emission

The target is to minimise CO₂ emissions by 2040 through a combination of four approaches:

- Replacing fossil fuel powered equipment and vehicles with electric alternatives,
- Generating clean energy on site
- Making existing buildings more energy efficient, and
- Purchasing only clean energy from the grid

The long-term expansion of the airport up to 32 million is supposed to create 12,000 new jobs and an additional £1.6 billion in economic activity. The airport would also become a leading

hub for green technology, research and finance. It will deliver a more sustainable and healthier future for the people of Luton. More information available in Ref. [9]

Utility table

Scenario 3	Passenger	Airport	EasyJet	Luton Council	Local vendors	Travel providers	Overall utility
Economic benefit	-1	1	-1	1	-1	-1	
Jobs	1	1	-1	1	-1	-1	
Environmental benefit	1	1	1	1	1	1	
Total	1	3	-1	3	-1	-1	4

Next steps

- How the Net Zero Carbon plan will impact on gasoline cars owned by Luton residents? Are they willing to scrap their car and buy/rent an electric one?
- Demographic, economic data is needed to understand how many people would use electric public transport and/or can afford an electric car in the future.
- What is main renewable source of energy that will be used in-place? (Solar, Wind, Hydro, Solid biofuels). Based on this knowledge, it is possible to plan to construction of the required tools in strategic areas with more source.

Summary

The above outlines a methodology which could be used to assess and maximise the utility of different strategic scenarios given the impact the scenario would have on the various relevant agents in Luton. Various next steps and discussion points are proposed to refine and develop the methodology.

2.2 How can we better understanding the evolution of Luton as a town?

In this section we are interested firstly to explore the changes in the use of physical premises and secondly how the transport system is utilised in Luton. In exploring the changes in the use of physical premises the group looked at data on all rateable properties in Luton. Fig. 2 (left) show the empty business properties that have a rateable value of over £ 10,000. The primary hotspot is the centre of Luton and the other spot is Bury Park. Fig. 2 (right) show the occupation by type between 1990 - 2021, highlighting the impact of COVID-19.

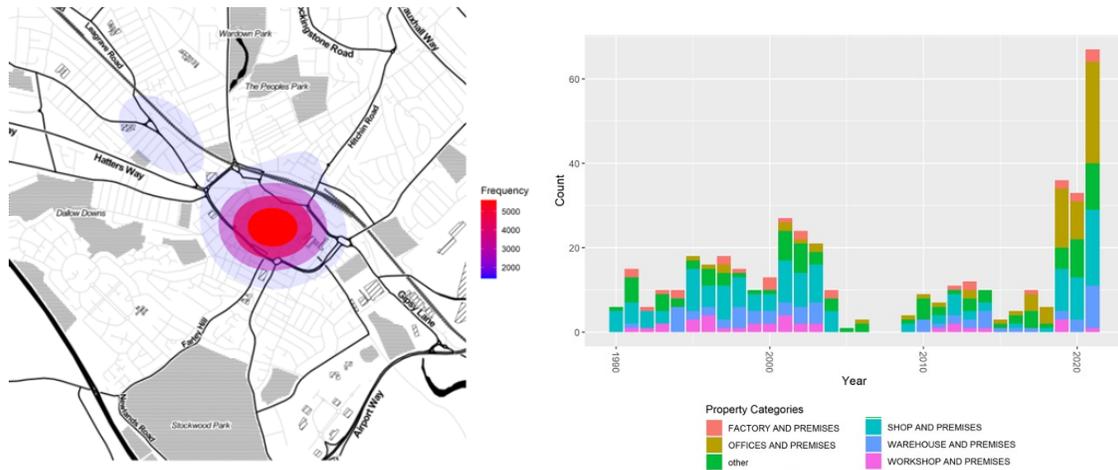


Figure 2: (left) Heat map of unoccupied premises with rateable value over £ 10,000 (right) Number of rateable business properties that became permanently empty in each year in Luton.

Fig. 3 shows the changes in specifically the warehouse occupation, the ones on the left show where warehouses are occupied, and on the right the ones which are currently unoccupied.

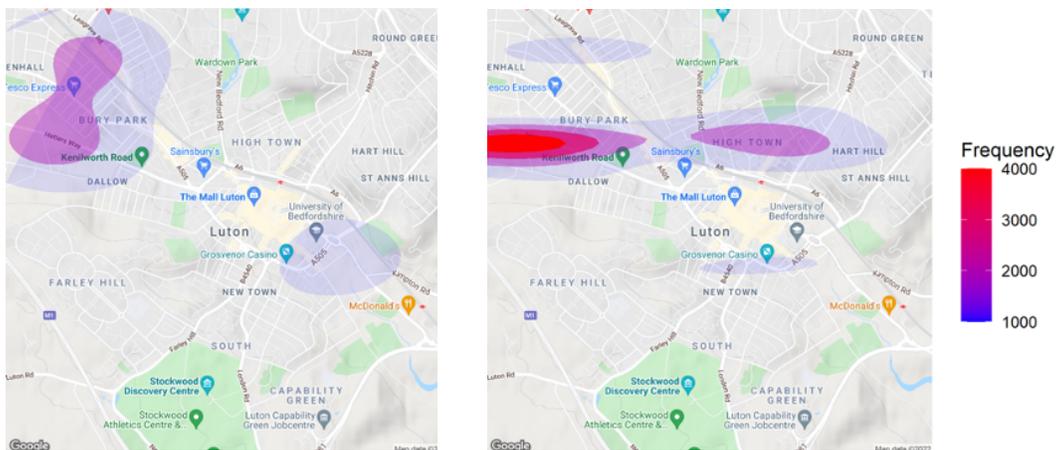


Figure 3: Heat map of warehouse (left) occupation and (right) unoccupied for rateable value over £10k

Luton as a flow network

The other element the group investigated relates to how the flow of people (specifically on road, rail and two-wheeled vehicles) occurs. Fig. 4 shows the key “nodes”, the group used this to developing a model that could be used to determine; (a) changes to services at different nodes and (b) changes to the strength of different arcs.

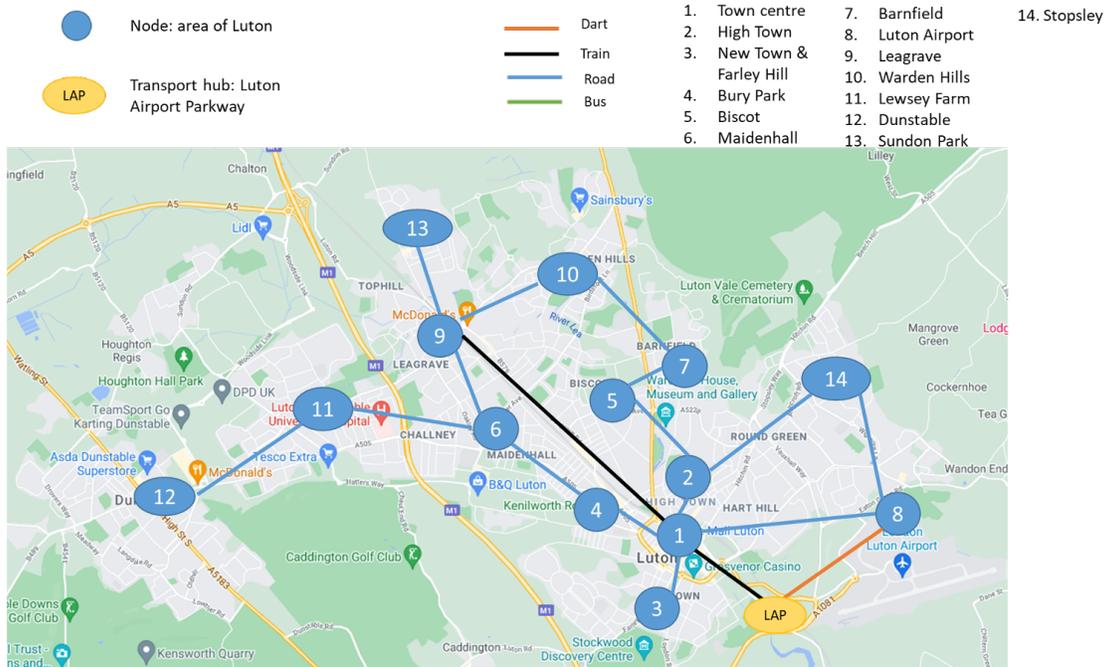


Figure 4: Luton as a flow network

To explore this, the group looked at data on transport use, in Fig. 5 we see the difference between **cars and taxis** versus **buses and coaches** on various parts of the flow network outlined above.

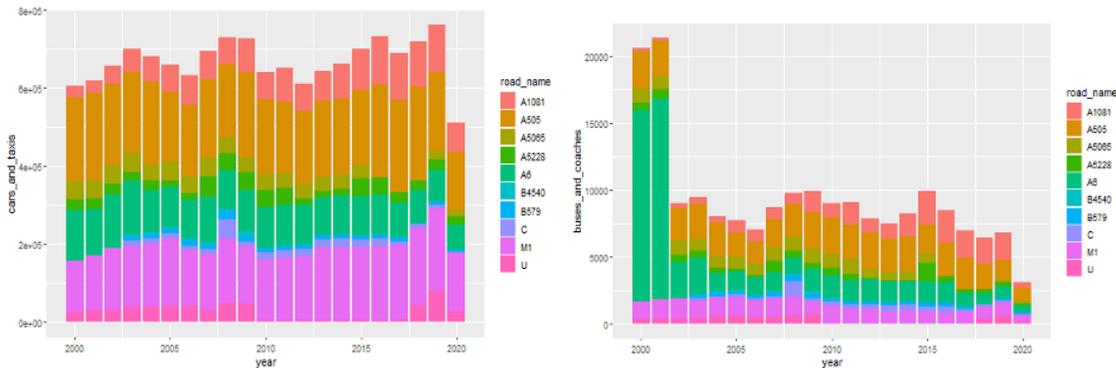


Figure 5: Cars & Taxis vs. Bus & Coaches Traffic - 2000 to 2020. Note different scales.

We can see the cars are used more frequently than the buses. Interestingly, we can see that between 2000 - 2001, a large use in buses, and then a subsequent reduction. During COVID-19, the use of buses has fallen significantly.

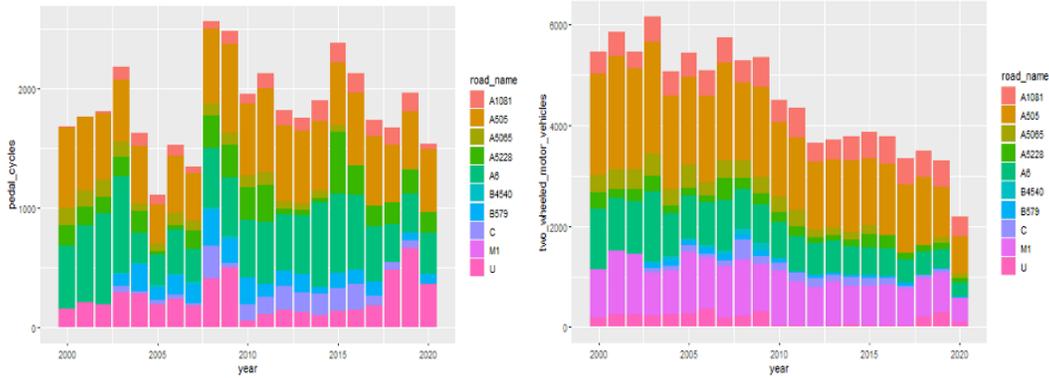


Figure 6: Cycle vs. Two_Wheeled_Vehicle Traffic. Note different scales.

Likewise, the traffic from cycling and other two-wheeled traffic can be monitored over the routes of interest over the last 20 years.

The group also looked at flow between specific routes which are more busy than the others. Fig. 7 and Table. 5 show the busy routes.

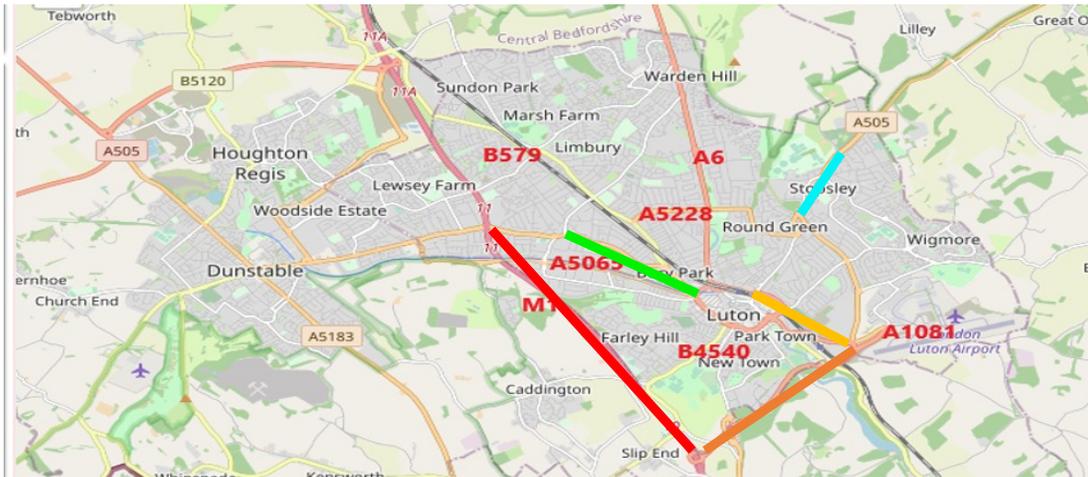


Figure 7: Top five busy routes for cars

road_name	start_junction_road_name	end_junction_road_name	cars_and_taxis_mean
M1	LA boundary	11	84938
M1	11	LA boundary	81397
A1081	LA boundary	A505	36231
A505	A6	Castle St roundabout	29254
A505	Castle St roundabout	A6	22964
A5065	Dallow Rd roundabout	A505	22830
A505	A5228	Mount Grace Rd	22519
A6	A505	New Bedford Rd	22285
A6	A6 non-trunk	LA boundary	20891
A5065	LA boundary	Dallow Rd roundabout	20775

Table 5: Top 10 busy car and taxi routes.

The aim of this data exercise is to try and understand why these routes are popular with cars and taxis and compare with bus routes to analyse to see if there are bus routes in the car busy areas, will this help reduce the car use in these areas?

Modelling the Impact of Changes to Infrastructure

This part considers planned, suggested and potential changes that could affect Luton's infrastructure. The short term changes relate to scenarios based on changing the network flow model of the current situation. These changes are summarised below:

Short term (next 5 years)	Long term changes (> 5 years)
Power Court	Autonomous vehicles: really interesting potential project here
Electric vehicles	Climate change initiatives
Redistribution of parking	Rise of the digital economy: changing demand for services

2.3 Conclusions

Next steps

Further aspects to consider modelling for Luton Airport:

- Which areas will be increased in the airport?
- Does the current expansion plans meet the needs of travellers? How well are they aligned over the COVID-19 period?
- Use flight schedules to optimize the co-location of the airplanes and impact on the queuing distribution at the gates.
- EEV charging/ car pooling model: If there are more electric vehicle all arriving at airport needing charge. leaving vehicle for a week, wanting charge when return, a valet service, parks it in an optimised way. Minimise the number of charging points you need and employ local people to do that.

Next steps for Luton town project:

- Changing use of physical premises: build a forecast model of business occupancy in Luton.
- Fully characterise the Luton flow network.
- Use the network model of the current system to determine impact of the new Power Court development and redistribution of resources on Luton.
- Determine the optimal operating model for autonomous vehicles in a town like Luton e.g. size of fleet needed, location of vehicle storage, pricing model.

References

- [1] https://www.luton.gov.uk/Council_government_and_democracy/Lists/LutonDocuments/PDF/Luton2020-2040/Luton-2040-strategic-vision.pdf
- [2] https://m.luton.gov.uk/Page/Show/Council_government_and_democracy/2040/Pages/Inclusive-economy-strategy.aspx

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- [3] https://m.luton.gov.uk/Page/Show/Council_government_and_democracy/2040/Pages/default.aspx
- [4] https://www.growinglutontogether.com/assets/documents/Report_GLT_Spreads_Final.pdf
- [5] https://m.luton.gov.uk/Page/Show/Council_government_and_democracy/Councils/Council_strategies_and_plans/Pages/Corporate%20Plan.aspx
- [6] https://m.luton.gov.uk/Page/Show/Council_government_and_democracy/Councils/Council_strategies_and_plans/Pages/default.aspx
- [7] https://m.luton.gov.uk/Page/Show/Council_government_and_democracy/2040/Pages/Luton-town-centre-masterplan.aspx
- [8] <https://cles.org.uk/the-community-wealth-building-centre-of-excellence/>
- [9] <https://lutonrising.org.uk>

3 City of Edinburgh Council

3.1 The National (Scotland) Context

In September 2017, the Scottish Government created an 'Ending Homelessness Together' Fund of £50 million over a five-year period to support homelessness prevention initiatives and pilot solutions to deliver results. This funding was designed to tackle homelessness across Scotland. The Homelessness and Rough Sleeping Action Group (HARSAG) was also formed to develop recommendations on the actions, services and any legislative changes required to end rough sleeping and transform the use of temporary accommodation.

HARSAG made recommendations [1] for the actions and solutions needed to eradicate rough sleeping and transform the use of temporary accommodation in Scotland. HARSAG also advised Ministers on how to ensure the recommendations are successfully implemented to secure rapid change and improvement towards the Government's goals. In Scotland all local authorities have Rapid Rehousing Transition Plans (RRTP) setting out their strategy for ending homelessness.

The Edinburgh Strategy

The City of Edinburgh Council strategy has 4 key objectives in its RRTP [2]

- Preventing homelessness in the first place.
- Where temporary accommodation is required this will meet the needs of the household.
- Supporting people to access settled accommodation as quickly as possible.
- Reducing the number of people sleeping rough.

The RRTP includes plans to increase prevention activity with a focus on earlier interventions and the development of pathways to prevent homelessness at key transition points, such as leaving hospital or prison.

The focus on prevention should also help with preparation for the introduction of any prevention duty in the future if legal duties are placed on wider public bodies to prevent homelessness. A Prevention Review Group was set up to investigate the potential for a prevention duty and provide recommendations to the Scottish Government [3].

Homelessness occurs for many reasons, in 2020/21 nearly half of all homeless applications in Scotland were the result of relationship breakdown or people being asked to leave [4]. Pre-

ventative activity is varied and aims to identify homelessness and to intervene, where appropriate, as early as possible.

The City of Edinburgh Council have various ways of identifying households who are at risk of homelessness or who have become homeless:

- Council tenants who have rent arrears, debts, or tenancy sustainment issues, such as reports of anti-social behaviour complaints or unmet support needs, may be identified as being at risk of homelessness.
- Individuals and households can approach the Council or a partner organisation for support or advice.
- Individuals and households may be identified as at risk through commissioned service or a service provider.
- A Section 11 notice could be received from a Registered Social Landlord (RSL) or Private Landlord, notifying the Council that the household is at risk of homelessness.
- A person who is preparing to leave an institution may be identified as at risk of homeless.

The eviction process is different for Social Tenants (Council and RSL) and for private tenants. Below are links to Shelter Scotland webpages explaining the eviction actions, timelines.

- [Social tenancy - Shelter Scotland](#)
- [Private tenancy - Shelter Scotland](#)

Data and statistics published on homelessness in Scotland and in Edinburgh:

- [Housing and homelessness statistics - Shelter Scotland](#) [5]
- [Homelessness statistics - gov.scot \(www.gov.scot\)](#) [6]
- [Homelessness in Scotland: 2020 to 2021 - gov.scot \(www.gov.scot\)](#) The main tables shows the data provided by all Scottish local authorities. [7]

Edinburgh has Particular challenges:

- Disproportionately high Private Rental Sector (PRS).

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- Disproportionately high rent charges in the PRS.
- Shortage of available settled (move on) accommodation.
- Shortage of suitable temporary accommodation.
- The expected growth of the city, with the number of households expected to be over 10% higher by 2029

More detail can be found in the RRTP. Examples of interventions can be found in the Edinburgh RRTP, many of them are summarised below.

- **Homelessness Prevention Working Group (HPWG)**, set up with Council and third sector partners working collaboratively to identify prevention opportunities and lead on prevention activity such as developing pathways for vulnerable groups; women and children who have been victims of domestic abuse, youth at risk of homelessness and for people at key transition points such as leaving hospital or leaving prison. In addition to this work is ongoing through the HPWG to map the client journey identifying key stages for reviews designed to use income maximisation to boost housing options and then tenancy set-up and sustainability.
- **Partnership Working Officer** – Recruited to train frontline Council staff, wider public service staff and staff working in the third sector to use their existing conversations with service users to identify where there may be a risk of homelessness and how to refer to the Council. This post will allow the Council to be well placed to respond to any legislative changes that come into force in the future.
- **Multi-disciplinary team (MDT)** – This team meet monthly to discuss households who are in council tenancies that are at risk of homelessness resulting from rent arrears and who are not engaging with housing officers. The team look at how they might engage with the household to offer support with a view to preventing homelessness. This team consist of personnel from various council services, such as: health and social care, advice, housing, through-care after-care.
- **PRS team** – To support tenants to stay in, or to access, PRS and Mid-Market Rent (MMR) properties.
- **Development of pathways for vulnerable groups** – Women and children who have been victims of domestic violence, youths at risk of homelessness, individuals at key transition points leaving institutions such as hospital or prison.

- **Family Group Decision Maker** – This is a mediation service that provides an opportunity for individuals or households to open channels of communication with family or friends who may be able to support them with their housing or other situation.
- **Edinburgh Help to Rent** – This is a scheme which provides a rent deposit guarantee bond and can offer rent in advance, help with furniture and access to other where support needed.
- **Youth Emergency Support Service (YESS)** – This service works with young people who present as homeless. The service diverts approximately half of the young people it works with from becoming homeless.
- **Income Maximisation Development Officer** – This post undertakes a range of awareness-raising activities with Council teams and external organisations, to promote understanding of how households can improve their financial security through accessing all welfare benefit entitlements and managing personal finances.
- **Long Term Supported Accommodation** - This service will provide support for men over the age of 35 who have a history of homelessness and long-term alcohol misuse issues.
- **Move on Flats** - Fully furnished flats with dedicated Resettlement Workers. Suitable temporary accommodation with a nomination agreement to allow direct access into permanent mainstream housing, this creates a seamless pathway out of homelessness and temporary accommodation.
- **Psychologists in Hostels Project** – In Edinburgh mental health is the most prevalent support need for homeless households. This pilot is to be based on learning from a pilot in London, where a psychologist was embedded in a hostel saw a reduction in rough sleeping and a reduction in evictions. This is still in development.
- **Link Workers** – This service supports service users at the Welcome Centre. The workers have been trained by Council staff to undertake provisional homelessness assessments and deliver on-site assessments to Welcome Centre residents ensuring that residents, who may have been former rough sleepers, have access to advice and support and are registered on EdIndex.
- **Tenant Grant Fund** – Short term Scottish Government discretionary fund, being administered by local authorities, to provide relief to tenants who have accrued rent arrears during a specific time period during the restrictions phase of the pandemic. This fund is designed to prevent loss of tenancy as a result of the financial impact of the pandemic.

3.2 Potential changes to homelessness legislation

Prevention Duty

The Scottish Government are currently undertaking a consultation on proposals for a new prevention duty on local authorities and other agencies. The key change being proposed is an extension of the duty for an LA to recognise a household as being at risk of homelessness when they may lose their accommodation in 6 months instead of the current 2 month consideration.

Local Connection

Currently in Edinburgh a household presenting to as homeless must have a local connection to Edinburgh in most circumstances. Edinburgh recorded the following information for homeless assessments in the period 2020/21. This may be reviewed in the future and may result in an increase in the number of individuals and households that the Council has a duty to house.

Local connection with this LA	Local connection with this LA and another LA	Local connection with only another LA	No known local connection with any LA	All
1,675	85	15	135	1,910

Table 7: Current figures for homeless assessments in the period 2020/2021.

The challenges posed by the City of Edinburgh Council on the first morning were:

1. Can modelling be used to predict the likely impact of the following for the City of Edinburgh Council?
 - Removal of local connection.
 - Changes to prevention duty.
 - Court action recommencing post Covid-19 particularly for Private tenants.
2. (What additional activities or focus should be undertaken to enhance the Council's work on homelessness prevention?)

3.3 What might be the impact of the removal of the local connection requirement?

Currently in Edinburgh a household presenting to as homeless must have a local connection to Edinburgh in most circumstances. Edinburgh recorded the following information for homeless assessments in the period 2020/21. This may be reviewed in the future and may result in an increase in the number of individuals and households that the Council has a duty to house.

Flowchart

This flowchart provides an overview of the steps the council will follow if you apply for help as homeless.

You can get further advice from england.shelter.org.uk/housing_advice, local Shelter advice service or local Citizens Advice. If you have nowhere to sleep tonight, are at risk of harm or losing your home within the next 2 months, call Shelter Helpline on 0808 800 4444 for advice and information on your options.*

*Calls are free from UK landlines and main mobile networks.



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Note
Information contained in this factsheet is correct at the time of publication. Please check details before use.

April 2021

Applying as homeless

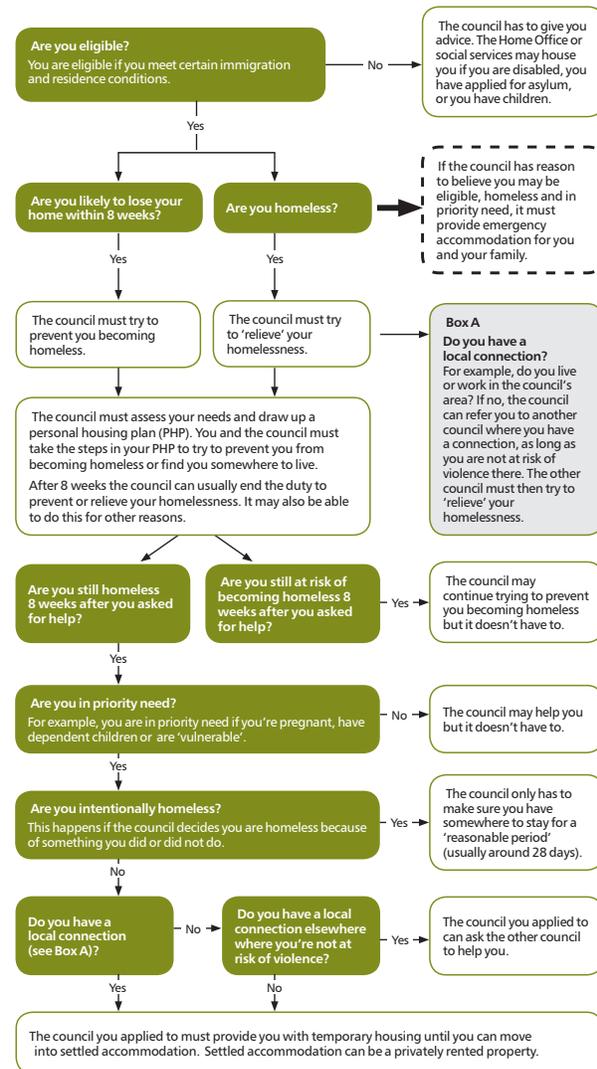


Figure 8: Applying as homeless. Reproduced from england.shelter.org.uk

The possible change in the local connection requirement can be seen as a change in the below part of the homelessness flowchart, indicated with a red arrow.



Figure 9: Remove requirement for a local connection, adapted from Figure 8

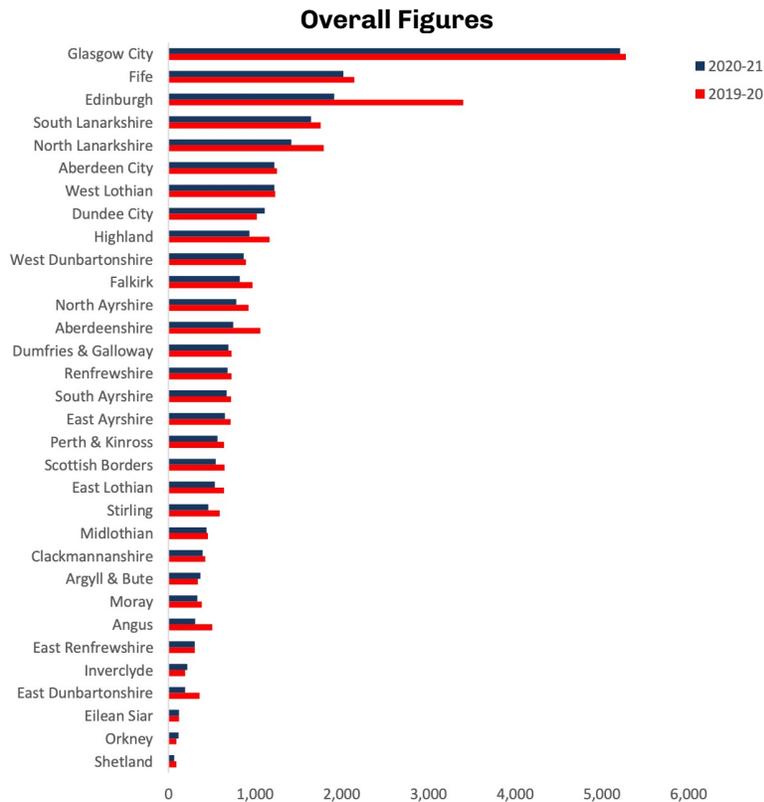


Figure 10: Number of homeless households by local authority [4]. Glasgow remains the local authority with the most households assessed as homeless, and saw a 1 % decrease compared to a 13 % fall overall. Assessments in Edinburgh fell by 44 % in 2020/21, falling behind Fife which had the second highest number of homeless households. The 44 % drop in Edinburgh recorded figures was apparently mainly due to expedited process but the particular local housing mix also played a role.

Modelled Flows To estimate how application numbers might change we redistributed applications according to internal population flows (ages 25-54) as recorded by census. To do this let

LA	Before	After	Change
Glasgow City	6335	6156	-179
Fife	2542	2377	-165
South Lanarkshire	2201	2059	-142
Edinburgh	2171	2839	668
North Lanarkshire	1686	1781	95
Aberdeen City	1464	1559	95
West Lothian	1464	1305	-159
Dundee City	1433	1361	-72
Falkirk	1072	1015	-57
West Dunbartonshire	1053	924	-129
Highland	1049	1083	34

Table 9: Number of households recorded as homeless by council areas. The column “Before” gives numbers corresponding to 2020-2021. “After” gives estimated numbers after migration corresponding to census data.

h_i be the previous number of homeless households in council i before the rule change. E.g. if $i = 1$ corresponds to Glasgow city then $h_1 = 6335$ according to table 9. f_{ij} describe migration rates from council i to council j . Note that

- $f_{ii} \neq 0$ i.e. corresponding to census figures for households who move house within their local authority area,
- $\sum_j f_{ij} = 1$ the total number of households remains constant under redistribution .

In this work we use census data on household moves for the (age 25-54 demographic) to estimate f_{ij} . We thus calculate updated figures

$$H_j = \sum_i h_i f_{ij}$$

E.g. for Glasgow we will have $H_1 = 6156$. The results of this calculation applied to the data shown in Figure 10 is shown in Table 9. A 30% increase in applications for Edinburgh is estimated.

Summary

Removal of the local connection criteria means a council must offer support to an applicant regardless of connection. Migration patterns, once this becomes a legal requirement, are not known. A simple estimate of effects can be made by applying the migration patterns seen when families move house as given by census data. For Edinburgh this process results in a

30 % increase in applications. This is however a very rough estimate. There are a number of ways in which it could be improved based on data driven and predictive modelling. Data driven modelling could be improved by considering the demographics of the homeless population and using the migration patterns appropriate for that demographic. Predictive modelling will be needed to consider secondary effects: the estimated 30% increase in homeless applications may stress the system resulting in a poor service thus driving additional migration. These and other second order effects could be addressed withing the Ordinary differential equation (ODE) framework discussed below.

To be more confident of predicting the effects of altering local connection, it is likely to be necessary to better: (1) represent the acceptance/ refusal to house homeless presentations with/without other LA connections under the present system; (2) model presentation of homeless households at other LAs, and how figures might depend upon circumstances (e.g. relative homelessness and rehousing rates in the originating LA and those in the destination LA).

3.4 What impact might changes in the prevention duty have on homelessness?

The Scottish Government are currently undertaking a consultation on proposals for a new prevention duty on local authorities and other agencies. Currently Council acts *when contacted* by a household in danger of homelessness in a 2 month timeframe. Proposed change to *proactively seeking* out households in danger of homelessness in a 6 month timeframe. Below we detail how a dynamical system model could be used to investigate interventions such as this, building on previous work by Lacey *et al* [8].

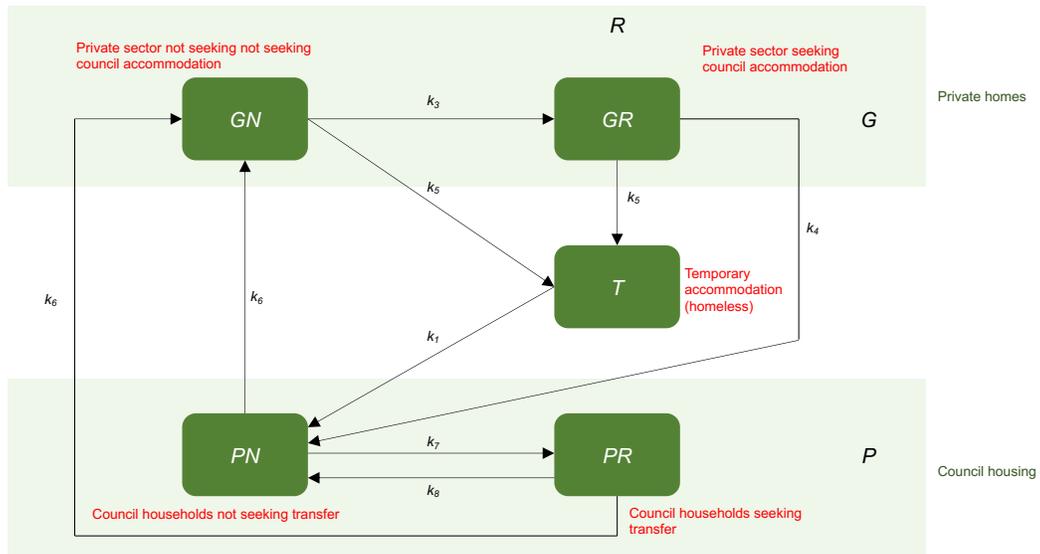


Figure 11: Transfer between different types of household. The k 's denote constants of proportionality governing the rates. [8]

Variables used in Fig. 11

T	no. households in temporary accommodation (the homeless)
PR	no. households in council stock and seeking transfer
PN	no. households in council stock and not seeking transfer
GR	no. households in private sector and seeking accommodation
GN	no. households in private sector and not seeking council accommodation
P	no. households in council stock = $PR + PN$
G	no. households in private stock = $GR + GN$
R	no. households on register = $T + PR + GR$

In [8] it is assumed that the homeless families only come from those in the private sector (councils will not evict tenants except for some misdemeanour, in which case the expelled parties are not considered homeless) and that the rates are proportional to those populations, with the same rate constant k_5 . The rates of moving from P to GN (due to improvement of circumstances), from GN to GP , and from PN to PR (perhaps some deterioration of conditions) are similarly taken to be proportional to the relevant populations (with constants of proportionality k_6 , k_3 , and k_7 respectively). The rates of rehousing were considered to be jointly proportional to the demand (GR , T , PR) and availability of council housing, $P_0 - P$, if $P_0 =$ total housing stock ($P =$ no. presently occupied), with respective constants k_4 , k_1 , k_8 . (This law allows arbitrarily fast rates of rehousing. The inclusion of a factor inhibiting the speed could be considered.)

Modelling accounting for vulnerable households.

The current problem requires a slightly different model to that investigated previously. We consider five major categories which in some cases are broken down into subcategories. These are summarised in Table 11. The main categories are households in owner occupied accommodation, households renting from a private landlord, households renting social accommodation, households not fitting into any of the above categories who are vulnerable (in the sense of the prevention duty), e.g. people coming out of prison or care, and homeless households. The owner occupied, private renters and social accommodation categories are further subdivided, in each case one subcategory is vulnerable (again in the sense of the prevention duty).

Populations are also broken down according to whether or not those renting are in arrears. Note that the model of [8] did not account for households being at risk of becoming homeless through being in rent arrears or otherwise considered vulnerable.

Owner occupier	U	u_1	Not vulnerable
		u_0	Vulnerable (e.g. family breakdown)
		v_2	Not Arrears
Private occupiers	V	v_1	Arrears
		v_0	Vulnerable
		w_1	Not vulnerable
Social accommodation	W	w_0	Vulnerable
Other vulnerable	X		
Homeless	Y		

Table 11: Proposed variables of the ODE model.

to/from	u_0	u_1	v_0	v_1	v_2	w_0	w_1	X	Y
u_0	0	*	0	0	0	0	0	0	0
u_1	*	0	0	0	*	0	*	0	0
v_0	0	0	0	*	*	0	0	*	*
v_1	0	0	*	0	*	0	0	0	0
v_2	*	*	*	*	0	0	*	0	0
w_0	0	0	0	0	0	0	*	*	*
w_1	*	*	*	*	*	*	0	0	0
X	*	*	*	*	*	*	*	0	*
Y	*	0	*	*	0	*	0	*	0

Table 13: Transfer terms in the ODE model anticipated to be substantially different from zero are indicated with a '*’.

In the context of these variables the enhancement of the Prevent Duty could be modelled by increasing the number of households categorised as being vulnerable. However, the larger number of people being treated by the council as vulnerable should lead, hopefully, to a reduction in homeless rates for those lying in the larger category. (This might suggest taking two levels of vulnerability when doing the modelling.)

Time constraints prevented a full development of the model. However, some consideration was given to which flows within the model would be most important. These are summarised in Table 13.

Flow terms may be *nonlinear* to indicate for example limited capacity or combining households and *non-conservative* for instance in the case of family breakdown one household will be replaced by several. In addition to transfer terms the model will also require source terms to include factors such as migration.

A preliminary investigation of relevant data was carried out. There is a large amount of data available that could be used for parameterising the model. However, a systematic survey of what is available is needed. Figure 12 gives an example of some relevant time series data.

Summary

The introduction of the proposed Prevention Duty will significantly change the number of people considered vulnerable and in need of assistance by their local authority. A predictive modelling approach is needed to understand the effects of this change. A dynamical system model along the lines of [8], but based on types of populations indicated in Table 11 could be used to model these changes. The model could be developed using existing data to model the current

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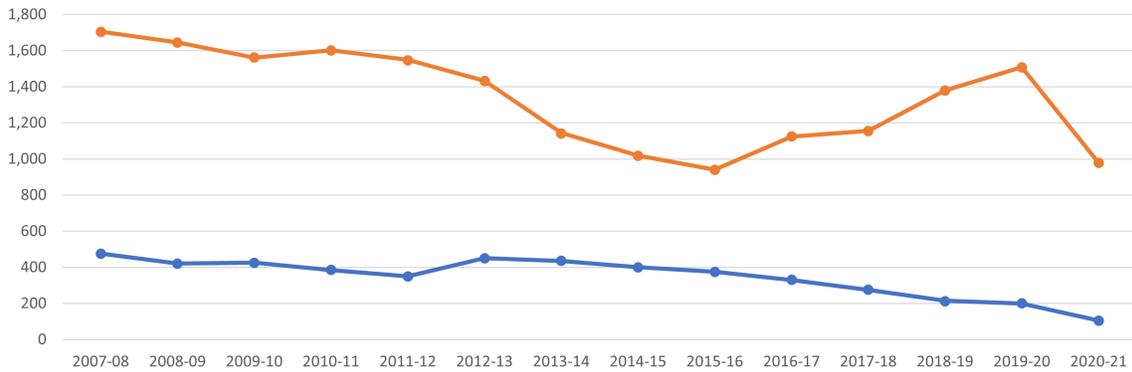


Figure 12: Edinburgh. (Orange) Households assessed as homeless or threatened with homelessness with at least one identified support need: related to $X + Y$?. (Blue) Households re-assessed as homeless within one year: term contributing to \dot{Y} ?

situation and then the parameters adjusted to reflect the proposed changes. Some very preliminary work towards developing such a model and identifying the data that could be used to parameterise it has been carried out. In accounting for expanded definitions of vulnerability, it could be advisable to further sub-divide the populations to account for households satisfying the new criteria who do or do not satisfy the more stringent old conditions. As noted above this model could also be useful in other contexts.

3.5 What impact might the recommencing of court actions have on homelessness?

During the pandemic period, evictions were prohibited thus there is most certainly a backlog of pending cases in addition to new cases accrued in the current period (March 2021 to April 2022). The impact of this extra burden of cases on the Local Authority requires investigation. Effective outcomes will depend on the LA resources with respect to their processing capabilities, housing stock and allowances. Whilst there appears to have been a dramatic fall in households assessed as homeless or threatened with homelessness in Edinburgh (Figure 11) this is likely to be due to a change in recording under the eviction stay and not a shift in circumstances for the LA, especially since this phenomenon has not been seen elsewhere in Scotland.

Homelessness Data

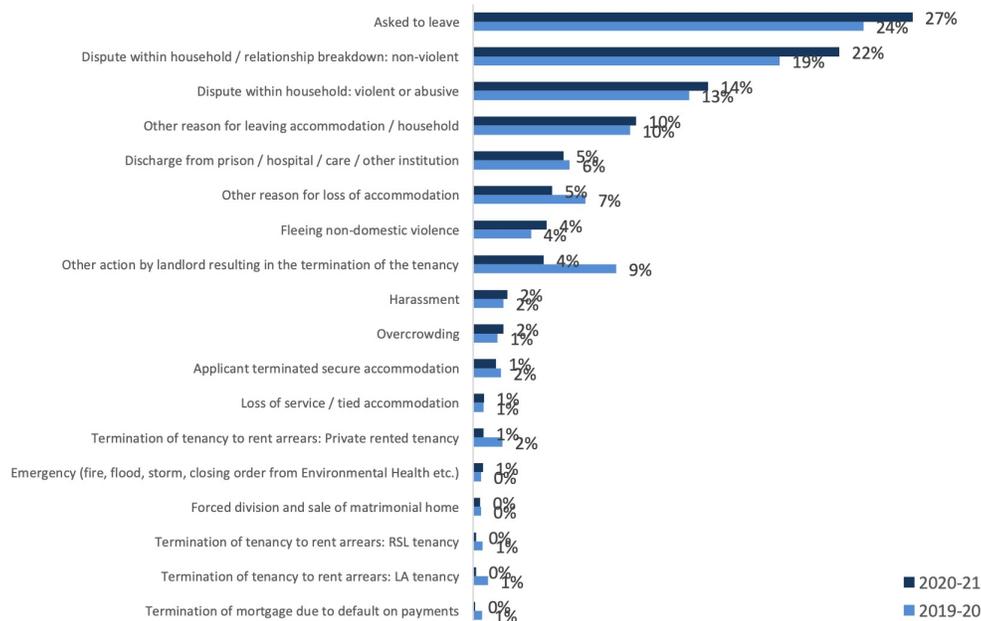


Figure 13: Main reasons for homelessness, 2020/21 [4]. The most common reasons for making a homelessness application were: (1) Asked to leave (27 %) (2) Non-violent household dispute (22 %) (3) Violent household dispute (14 %)

The percentage change for both **other action by landlord relating in the termination of the tenancy** and **termination of the tenancy due to rent arrears: Private rented tenancy** roughly halved during COVID

A challenge here is obtaining data describing private evictions. These are dealt with by the

Case Reference	Tribunal Rule	Hearing Date	Applicant	Respondent	Decision file	Upper Tribunal Decision(s)
ETS /HP C/E V/2 1/2 194	• Rule109	23/12/2021	Gary Brown	Heather McLean	Written Decision (with Statement of Reasons) 21.2194 Redacted.pdf	
			<i>Eviction Date</i>	<i>Details and Decision</i>		
ETS /HP C/E V/2 1/1 705	• Rule109	31/01/2022	Elizabeth Birkbeck	Joseph Nelder	Decision Rejection 21.1705 Redacted.pdf	
ETS /HP C/E V/2 1/1 870	• Rule109	23/12/2021	Property Management Options	I Stevenson	decision 1870 Redacted.pdf	
ETS /HP C/E V/2 1/2 586	• Rule109	23/12/2021	Helen Cargill	Ross Heenan	Written Decision (with Statement of Reasons) 21.2586 Redacted.pdf	

Figure 14: Private evictions dealt with by the Housing and Property Chamber: annotated screenshot from <https://www.housingandpropertychamber.scot/>

Housing and Property Chamber. Their website gives details of individual cases as show in Figure 14. However aggregated statistical data is not available. If an alternative source for this cannot be found then a significant amount of work will be needed to convert the available data into a form suitable for statistical analysis.

Summary

Preliminary investigation of the available data suggests that there is a backlog of pending eviction cases as rates of evictions by private landlords due to, for example, rent arrears were halved during the pandemic. There is a challenge to obtain data suitable for statistical analysis from the body processing private accommodation eviction cases. However once this data is obtained the ODE model described above could be used to model the subsequent dynamics.

Fuller modelling will need to consider what has been happening in the intervening period, between households getting into arrears and the delayed court case taking place: Will households have moved out any way? Become homeless for another reason? Got into worse financial difficulties? (Or possibly things might have improved.) Would increase/reduction of arrears, or longer time in arrears, affect the chances of eviction? And how might the initial conditions have been affected by Covid? If modelling arrears, should amount of arrears be modelled?

3.6 Conclusions and next steps

Local Connections If the requirement for assistance as homeless applicants to have a local connection is removed, the LA will be required to offer support to applicants without a local connection to the LA. Edinburgh received 15 applications from applicants with a connection to another LA in 2020/ 21 which it would be expected to support if the policy were introduced. In 2020/21 this was a small proportion of the total assessments, 1,910. If those seeking support for homelessness were free to apply to any LA, and homeless migration figures replicate those of the general population, the number of homelessness applications to Edinburgh is anticipated to increase by 30%.

Prevention duty A second proposed policy change is the move from offering support for those actively seeking assistance when they are at risk of homelessness within a two month window to proactively contacting at risk cases and offering support when there is a risk of homelessness within six months. Identifying key pressure points and optimal intervention policies is crucial and a holistic mathematical model is needed. A draft ODE model has been sketched out which can be used to investigate consequences once parameterised.

Evictions Preliminary investigation of available data shows that there was a substantial reduction in evictions by private landlords during COVID restrictions. This suggests that there is a backlog of cases. An obstacle to further analysis is that detailed data from the body responsible for processing eviction proceedings is not available in a form suitable for statistical analysis.

Further Work

There are three areas that future work should focus on. The first is a detailed survey of the available data. There is a large amount of data available and it was not possible to go through everything available over the period of the study group. Additional analysis to ascertain the suitability of the current data for model prediction is also necessary as is a long term time series model identifying underlying trends and seasonal factors.

Second would be the development of the ODE model sketched. This could be used to

- Evaluate efficacy of current practices and interventions.
- Improve the proposed migration estimates, including taking into account secondary and long term effects due to wider knowledge of policy to remove the local connection re-

quirement for support.

- Obtain improved measurements pertaining to category risks and flows.
- Investigate interlinked service support from major sections contributing to the homeless population e.g. care leavers, hospital and prison discharges.
- Use critical path analysis to focus improvements and interventions efficiently.
- Carry out scenario testing of policy interventions.

Although not investigated during the study group a third area for future research suggested by the detailed data available would be explore the idea of setting up an agent based simulation model. Although such models involve more computational complexity than the simpler ODE model described above they allow a more diverse population to be modelled which may be more representative of the system.

References

- [1] <https://www.gov.scot/binaries/content/documents/govscot/publications/corporate-report/2020/07/homelessness-and-rough-sleeping-action-group-final-report-tackling-coronavirus/documents/harsag-final-report-on-homelessness-after-coronavirus/harsag-final-report-on-homelessness-after-coronavirus/govscot%3Adocument/HARSAG%2BCovid%2Bfinal%2Breport.pdf>
- [2] <https://democracy.edinburgh.gov.uk/documents/s26277/RapidRehousingTransitionPlanReport.pdf>
- [3] <https://www.gov.scot/news/preventing-homelessness/>
- [4] <https://www.gov.scot/publications/homelessness-scotland-2020-2021/>
- [5] https://scotland.shelter.org.uk/housing_policy/key_statistics/homelessness_facts_and_research
- [6] <https://www.gov.scot/collections/homelessness-statistics/>
- [7] <https://www.gov.scot/publications/homelessness-scotland-2020-2021/documents/>
- [8] A. Lacey, J. Byatt-Smith, M. Grinfeld, S. Llewellyn Smith, T. Lowe, D. Parker, K. Parrott, C. Please, W. Smith, and J. Wattis, Mathematics in Industry Reports (2021). This content is a preprint and has not been peer-reviewed.

4 List of Acronyms

HARSAG The Homelessness and Rough Sleeping Action Group

HPWG Homelessness Prevention Working Group

LA Local authority

LBC Luton Borough Council

ODE Ordinary differential equation

PRS Private Rental Sector

RRTP Rapid Rehousing Transition Plans

RSL Registered Social Landlord

VSG Virtual Study Group



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