lift Industry News

A UK-BASED MAGAZINE WITH A GLOBAL OUTLOOK FOR THE LIFT AND ESCALATOR INDUSTRY

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Winter 2023 | Q1 Issue Three

lift Industry News

UK-BASED MAGAZINE WITH A GLOBAL OUTLOOK FOR THE LIFT AND ESCALATOR INDUSTRY

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NICK MELLOR OVERVIEW

Welcome to the third edition of Lift Industry News

I am delighted to have been asked to be the guest editor for the third edition of Lift Industry News.

While we look forward to the new year, we should also celebrate two great events in the industry's calendar towards the end of 2022 - LIFTEX and the Lift & Escalator Symposium (LES).

The success of LIFTEX reflects the strength, confidence and professionalism of our supplier members (who take a leading role at LIFTEX) and also of a wide range of our contractor members including some notable new exhibitors. Post-Brexit, as we emerged from lockdowns, and more recently with global instability and economic challenges, the success of LIFTEX was by no means assured; it was especially heartening to have the support of our members. We are very grateful to those and everyone who invested the time and care into their stands and helped make LIFTEX 2022 such a success. We look forward to a LIFTEX in 2025 with confidence and anticipation.

LEIA organises LIFTEX on behalf of the industry and its clients, while offering authoritative seminars of interest to the sector. I was blown away by the high quality of the seminar presentations and would like to thank the excellent presenters. The content of the seminars is of key importance to the sector and so I reflect further on them on page 34 in the LIFTEX review.

The Symposium was back in September 2022 after two virtual events. Over the years, the Symposium has built a community and the two days was a much needed opportunity to re-connect, catching up with old friends and making new ones. These include the exhibitors who are such a great support to the Symposium. The Trustees of the charity are very grateful for their support and everyone who contributed to the fundraising in 2021.

You'll find the Symposium review on page 57 and the Knowledge Bank section on page 61. LES always produces great papers which are peer-reviewed and it was great to see a number of new authors/presenters. The call for papers for the 2023 is out if you would like to present a paper.

Our lift and escalator community is increasingly global. I have been privileged to participate in a small way in the development of international standards and to have had the opportunity to learn from other countries, often looking to solve similar problems, perhaps in different contexts. TAK Matthews gives a fascinating insight into the fast-growing Indian market on page 50.

At LEIA, we already have much of the 2023 programme taking shape. LEIA is driven by its Management Board, its Council of members, and by the excellent work of its hard-working specialist committees. We are very grateful to Lift Industry News for providing us the opportunity of the regular LEIA News article – in this issue we highlight issues from our recent Technical Seminar, news on 'LEIA Achievement' – our apprenticeship end-point assessment service, and our ongoing work to support apprentice learning.

Apprenticeships are very close to LEIA's heart and in an article about the trailblazing women in the industry on page 41 you can find out about Carey Oakes from Knowsley Lifts who started as an apprentice some 32 years ago. She is in excellent company with three other women in our vibrant industry.

I hope you enjoy this issue, and look forward to working with many of you through 2023.

Our guest editor for this issue is Nick Mellor, Managing Director of the Lift and Escalator Industry Association (LEIA) where he has worked since 2012. Nick has been in the lift industry since 1992.

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lift Industry News

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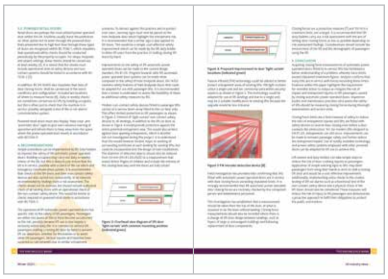

THE INTERVIEW
From a family run business to the largest independent manufacturer specialising in lift safety. We talk to SafeLine's UK CEO Stuart Garcia for a real insight into success.

THE KNOWLEDGE BANK
Dr Ali Albadri looks at how fractal dimension and the Poincare map can be used as tools to recognise and to distinguish between bad and good escalators, Daniel Meekin investigates the Closing Force of Passenger/Goods Lift Automatic Power Operated Doors and we feature David Swinarski's research paper on Modelling elevator traffic with social distancing in a university classroom building which recently won the CIBSE's Napier Shaw Bronze Medal for Research.

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lift Industry News

CALENDAR 2023

31 Tues — **January**

Nordiska Hissmässan
January 31

STOCKHOLM, SWEDEN

23 - 25 Tues to Thurs — **May**

ExpoElevador
May 23-25

SÃO PAULO, BRAZIL

20 - 21 Weds to Thurs — **September**

Lift & Escalator Technologies Symposium
September 20-21

NORTHAMPTON, UK & ONLINE

21 - 23 Tues to Thurs — **February**

Elevator Escalator Expo
February 21-23

GANDHINAGAR, GUJARAT, INDIA

20 - 22 Tues to Thurs — **June**

Elevcon
June 20-22

PRAGUE, CZECH REPUBLIC

16 - 20 Mon to Fri — **October**

CTBUH International Conference 2023
November 16-20

SINGAPORE

09 - 12 Thurs to Sun — **March**

Asansor Istanbul
March 9-12

ISTANBUL, TURKEY

22 - 24 Tues to Thurs — **August**

Global Lift & Escalator Africa
August 22-24

JOHANNESBURG, SOUTH AFRICA

17 - 20 Tues to Fri — **October**

Interlift
October 17-20

AUGSBURG, GERMANY

12 - 14 Fri to Sun — **May**

Lift Expo Morocco
May 12-14

CASABLANCA, MOROCCO

04 - 07 Mon to Thurs — **September**

Lift City Expo Jeddah
Sept 4-7

JEDDAH, KSA

15 - 17 Weds to Fri — **November**

Global Elevator Exhibition
November 15-17

MILAN, ITALY

/2024

09 - 11 Thurs to Sat
May

Inelex
May 9-11

IZMIR, TURKEY

16 - 18 Mon to Weds
September

The Elevator Show
September 16-18

DUBAI, UAE

01 - 02 Tues to Weds
October

E2 Forum
October 1-2

FRANKFURT, GERMANY

LIFT & ESCALATOR TECHNOLOGIES SYMPOSIUM

The 15th Symposium will take place on 20-21 September 2023 at the Hilton Hotel, Northampton, UK.

It brings together experts from the field of vertical transportation, offering opportunities for speakers to present peer reviewed papers on the subject of their research. Speakers include industry experts, academics and post graduate students.

Speakers are invited to submit abstracts at *https://www.liftsymposium.org*

ELEVCON

The International Association of Elevator Engineers (IAEE) and the new Chairman for Elevcon, Marja-Liisa Siikonen, M.Sc, Ph.D., CEO of MLS Lift Consulting Ltd are all systems go for the conference to be held in Prague in June 2023. There will be some fascinating papers on a wide range of topics from Vertical High Schools to the impact of IoT, Big Data and artificial intelligence on lifts, an historical overview of multidirectional, cable-less elevator systems and linear permanent magnet synchronous machines for ropeless lifts.

https://elevcon.com/

A NEW CHANGEMAKER AT THE UNIVERSITY OF NORTHAMPTON

The University of Northampton is well known for its teaching and research with and for the lift industry. In this piece we introduce a new department and find out about what the links to the United Nations Sustainable Development Goals and Changemaker are.

UNIVERSITY OF NORTHAMPTON

The University of Northampton is a designated global Changemaker Campus, one of only 50 in the world. We believe anyone can make a unique contribution to creating a better world, transforming lives, and inspiring change. We work together with our industry partners to make a positive social, environmental, cultural, and financial impact. We collaborate in our heritage areas, in particular the leather and lift industries, drawing on specialist knowledge from global leading professors. We bring together industry, with its talent, experience and know-how and academia, with its research, knowledge and expertise to solve problems and develop ideas.

At the heart of this is our Centre for Advanced Technologies, a research centre that exemplifies our approach. The ICLT responds to scientific and technological needs of industries including the lift, engineering, construction and manufacturing industries. The Centre supports them with their business goals alongside bringing solutions to societal imperatives of sustainability and social value.

NEW DEPARTMENT AT THE UNIVERSITY

Eleanor Morris joined the University of Northampton as Head of Commercial Development (Enterprise) at the start of this academic year and supports the Centre's work. Not only is Eleanor new to the University, but so is her role and entire department. Her department aims to make sure that the University and Centre are accessible for and approachable by businesses, to become a trusted advisor and thought leader with whom they can collaborate to achieve their business goals.

CHANGEMAKER AND UN SDGS

The department aligns its work to the Sustainable Development Goals of the United Nations including: Industry Innovation and Infrastructure; Sustainable Cities and Communities; Decent Work and Economic Growth. This links closely to the Changemaker ethos of social value and impact. Essentially, supporting the sustainability of industries, organisations and their workforces is a key focus for the department.

SO WHAT DOES THIS MEAN IN PRACTICE?

In addition to our specialist lift technology teaching, that includes delivery hand in glove with LEIA at the foundation and undergraduate level, Eleanor is looking to develop solutions that will address workforce or skills gaps in other areas. These include operations management, business systems thinking and leadership, all supporting the sustainability of the current workforce and developing the next generation. Eleanor is working through this approach with other sectors, but lifts were her first port of call.

"The Lift Industry was a natural place for me to start" says Eleanor, "It is one of our heritage industries, but most importantly is it is an area that brings together so much of our expertise. It encompasses the spirit of innovation in engineering, the technology progress in artificial intelligence and machine learning, but also sustainability."

"One of my first tasks was to understand the industry, its unique function and the people involved in shaping it," continues Eleanor, "I'm currently working on a deep dive to get to the bottom of what is needed to propel the industry to new heights and integrate the work that is happening between academic and industry to ensure full sustainability."

As part of this work, Eleanor is bringing together a virtual focus group from a range of organisations across the sector and would welcome volunteers to join her. Please contact her at ***Eleanor.morris@northampton.ac.uk*** for more information.

LIFT ENGINEERING @ NORTHAMPTON

University of Northampton

Academic qualifications:

- University Certificate in Lift and Escalator Technology
- Higher National Certificate (HNC) in Lift and Escalator Technology
- Higher National Diploma (HND) in Lift and Escalator Technology
- Masters (MSc) Lift Engineering

Engineering Council accredited degree

This degree has been accredited by the Institution of Mechanical Engineers under licence from the UK regulator, the Engineering Council. Accreditation is a mark of assurance that the degree meets the standards set by the Engineering Council in the UK Standard for Professional Engineering Competence (UK-SPEC)

Postgraduate Research (PGR) programme:

Undertake research degrees for the award of MPhil (Masters by research) and PhD (Doctorate)

- Systems engineering of lifts and escalators
- Ride quality, dynamics and vibration
- Intelligent fault detection and maintenance
- Control system
- Computer modelling, lift traffic analysis and simulation

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Email: sarah.field2@northampton.ac.uk

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Are procedures a substitute for shortcomings in building design?

POINT OF VIEW

Let me start by asking a simple question: how familiar are you with the office and building procedures at your place of work? This may appear to be a random question, the reason for which I hope will become obvious.

I'm sure you won't be surprised to learn that when looking at how buildings operate, much of the everyday functioning is driven by aspects of the original design. This is derived from the various strategies applied during the design process and is meant to provide a safe and efficient means of operating the building once completed.

When looking at the design process there are a multitude of considerations to be factored in. Buildings are complicated to both design and build. In the UK the process generally follows the RIBA design stages taking account of the various requirements necessary to reach a compliant design which also satisfies the client's brief and objectives.

Whilst statutory and compliance requirements are guided by the law, codes, standards, etc. a second key element of design comes from thinking about how the building will operate and what is needed to ensure the facilities provided offer practical working solutions. This element isn't covered by codes or standards but is driven by an understanding, experience and knowledge of how buildings work on a daily basis.

We are all familiar with the design strategies applicable to new buildings covering things such as fire and escape, plant replacement, façade access and security, to list a few. Many are driven by the need to comply with the Construction Design and Management Regulations (CDM) aimed at making buildings safe to construct, maintain, repair and ultimately demolish. Add to this the supporting standards and codes covering virtually all aspects of building services, facilities provision and operation and you hopefully have efficient operating buildings.

However, is this really the case? As we know, when it comes to standards, the minimum is often the maximum and there are many instances where building operational requirements are compromised by the 'it complies' approach.

But what about the role of operational procedures that might be envisaged to compensate for deficiencies in the design? I have to emphasise I am not speaking of compliance here, but where the design creates a potential operational issue for which, 'a procedure', is seen as the solution.

Let me give an example. A pair of escalators are proposed for a development and form a major artery for access and egress. To the architect and design team this is the only solution and has to be adopted. Attention focuses on the structural design requirements and ultimately the architectural appearance of the escalators. However, a major design consideration should be what happens if one of the escalators is out of service; is there an alternative means of access? A fixed centre staircase between the escalators or perhaps an adjacent set of stairs, even a third escalator, any of which provide an efficient and convenient alternate means of people flow. Pose this question and you either encounter a quizzical look or alternatively a response along the lines of, "It's a building management issue"; for this read, it's not something we see as our responsibility as it's 'an operating procedure' best devised and implemented by the building management team. Really? What alternatives does the design offer to manage the situation? This really isn't a question of building management procedures but one of design. The truth is probably the design team haven't considered the question.

At this point you would hope the VT consultant would step in and point out the issues associated with the use of escalators as fixed staircases and the dangers of two-way traffic on a single escalator. In these circumstances the VT consultant is in an invidious position. Appointed by the client to provide a working VT design compliant to relevant standards and codes, they can only advise and if that advice isn't accepted then they are overruled.

So, what is the alternative means of access? In many instances back of house access stairs offer a solution but these are not always easy to reach and can bring issues of security, way finding and impact on other elements of the building operation. In one instance the proposal was to take stairs that led people out of the building via the loading bay.

A second example relates to lobbies of dedicated goods lifts. With space at a premium there is significant reluctance, or outright opposition, to providing suitable space in front of the goods lifts for storage of goods, wheelie bins, cleaning equipment etc. prior to being loading into the lift or distributed onto the floors. When raised as an issue you are invariably met with a response of, "It's a building management issue". This illustrates a lack of understanding of how buildings work and the day-to-day issues confronting facilities teams trying to ensure a smooth running operation. If the goods lift also happens to be the designated evacuation lift the problem is compounded by the need to keep the lobby clear at all times. The use of dedicated goods lifts for evacuation purposes is another discussion but one I would see carrying significant risk when it comes to accessing potentially congested lobbies designated as safe spaces.

A further important issue is; do tenants want unsightly wheely bins, perhaps filled with pungent food waste, cleaning and perhaps building materials standing on their floors waiting to be distributed or removed at night?

These are just two examples of many, where a lack of understanding at the design stage impacts facilities management in trying to run an efficient operation and has come about as a direct result of deficiencies in the design.

The unseen side of these deficiencies can lead to expensive solutions for the ongoing life of the building, something the developer and design team can see as someone else's problem once the building is finished and perhaps sold. The need to undertake operational activities or repairs at night, or over weekends, is expensive and, in many instances, avoidable if the design takes account of the operational factors from the outset. This of course can mean initial increased capital costs, and yes, there could be a loss of rentable area, but, if the operational requirements are fully understood and considered at the outset a cost effective solution can often be found.

It does appear the 'get out of jail' card for the design team is often an operating procedure managed by the building services provider. These procedures are often recorded in the building's operation and maintenance manuals (O&Ms) which are not always read or appreciated following project completion.

So, going back to the original question; how familiar are you with the office and building procedures at your place of work?

I'm sure you will be familiar with key safety procedures, such as escape in the event of a fire, but are you or your colleagues aware of procedures for the storage and distribution of goods/materials because of a lack of temporary storage in a lobby outside the lift? What is the procedure if an escalator fails and you have to use an alternate route? You may well say this resides with the facilities management provider; on the other hand, you might be only too aware of the issues because you regularly experience then in the daily running of your business. Whichever, I would wager that the majority of building users and maintenance providers have little or no knowledge of procedures that fall outside of the everyday building operation and fire safety requirements.

I would also suggest that where, what I would call 'exception procedures', have been established as part of the design process, they have either been forgotten, never known in the first instance or simply ignored. Contained in the O&Ms they are often hidden from view and not obvious, and as such, may never have been implemented. Turnover of staff, maintenance contractors and service providers mean things can become disjointed and when combined with a lack of training and review processes it is often found the best intended procedures are simply forgotten.

Taking the example of goods lift lobbies one approach to mitigating the difficulties might be to fit notices, but if the reasons for the notice isn't obvious, they become ineffective; what's wrong with storing things in the goods lift lobby? Who knows it is meant to be a safe place for those needing evacuation in an emergency?

Don't get me wrong, procedures are an important part of building operations but are not always policed correctly and lapse, lost with the passing of time.

At the heart of my initial question is the understanding of how building design develops and the various strategies adopted in attempting to overcome shortcomings in design. The bigger question is how do you overcome the lack of understanding? Clearly education forms part of the answer together with designers visiting projects after completion and talking to those running the building, facilities managers, cleaners, loading bay managers and back of house staff. They will not be short in highlighting the shortcomings.

Ask how often this happens and you will not be surprised to learn, rarely, if ever.

Reliance on a building management procedure to overcome a design shortcoming is not new and can sometimes provide a pragmatic solution. When this approach is taken with a full understanding of its implications and is managed effectively it can provide a working solution. However, with better understanding and wider appreciation of how buildings work the design process is better informed and consequently offers better solutions. The alternate begs the question; should there be an enforceable standard considering building design from the user's standpoint and addressing their needs as part of the process? I will leave you to ponder the answer.

BIOGRAPHY

Len Halsey spent a major part of his career with Otis, holding senior technical and managerial positions, before joining Canary Wharf Contractors in 1998. He was appointed Project Executive for Vertical Transportation Systems in 2002 responsible for VT design across the range of developments undertaken by Canary Wharf including, office, residential, retail and infrastructure projects. He retired from Canary Wharf Contractors in 2019 and is now retained by the company as a consultant. He is a member of CIBSE and a former chair of the CIBSE Lift Group.

FROM THE ARCHIVES

MAXIMUM number of passengers

We asked Gina Barney to take a look back into her library and choose something from the archives of interest to our readers today.

This extract is taken from the Handbook to EN81-1:1985 by Andre Leenders in 1986

Lift Industry News republished my paper *Rated load and maximum available car area – a proposal to revise EN81-20, Table 6* that I gave at the Lift and Escalator Symposium in September 2022. This paper explains that the area associated with the rated load of a lift car is too small to accommodate passengers comfortably. It proposes increasing the available car area for each rated load as shown in Table A below.

There is a 15 minute video of my presentation at: *https://youtu.be/1kMO06e8_Yc*

CAR AND COUNTERWEIGHT

8.2.1: Car dimensions

The recommended dimensions are given by the following ISO standards:

- ISO 4190/1 : Class I lifts (passengers lifts)
  Class II lifts (passengers-goods lifts)
  Class III lifts (hospital lifts)
- ISO 4190/2 : Class IV lifts (goods lifts = freight elevators)
- ISO 4190/3 : Class V lifts (service lifts = dumbwaiters)

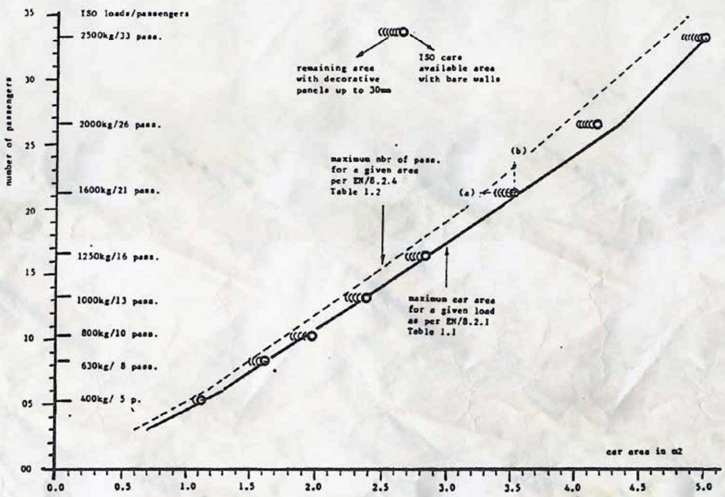
The ISO dimensions are based on the CEN specifications but the ANSI requirements are very close.

8.2.4 Maximum number of passengers

8.2.4/a)
The CEN/TC 10/WG 1 correctly decided to allow some margin to avoid that the carrying capacity of a lift expressed in number of passengers ought to be modified if the architect decided to change the decoration of the walls.

For example, the ISO lift 1600kg/21 passengers has exactly the available area corresponding to Table 1.1 of EN/8.2.1 when the car walls are bare. Thanks to the margin resulting from the table 1.2 of EN/8.2.4, the same lift may still be called 1600kg/21 passengers when 3 of the walls are decorated with panels 30 mm thick.

The Figure 7 illustrates that margin for car areas up to 5 m2 and rated loads up to 2500 kg/33 passengers.
All the ISO loads for Class I, II and III lifts are indicated.



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The four volumes of the Leenders Handbook can be found at:
https://liftescalatorlibrary.org/paper_indexing/abstract_pages/00000518.html

Table A Proposed maximum available car area (Col 3) compared to present value in EN81-20:2020, Table 6, Table 6 (Col 2) for common rated loads (Col1)

Rated load (kg)	Maximum available car area to EN81-20:2020, Table 6 (m^2)	Proposed Maximum available car area (m^2)
450	1.30	**1.26**
630	1.66	**1.76**
800	2.00	**2.24**
1000	2.40	**2.80**
1275	2.95	**3.57**
1600	3.56	**4.48**
2000	4.20	**5.60**
2500	5.00	**7.00**

What does Andre Leenders have to say on this matter?

8.2.4 Maximum number of passengers

The CEN/TC10/WG1 correctly decided to allow some margin to avoid that the carrying capacity of a lift expressed in number of passengers ought to be modified if the architect decided to change the decoration of the walls.

For example, the ISO lift 1600kg/21 passengers has exactly the available area corresponding to Table 1.1 of EN81 {1985} when the walls are bare. Thanks to the margin resulting for Table 1.2 of EN81 {1985}, the same lift may still be called a 1600kg/21 passenger when 3 of the walls are decorated with panels 30mm thick.

Note 1: Table 1.1 morphed into the current Table 6
Note 2: Table 1.2 has morphed into the current Table 8

The Figure 7 [shown here as the first page of this article] illustrates that margin for car areas up to 5m² and rated load up to 2500kg/33 passengers. All the ISO loads for Class I, II and III lifts are indicated. See the Leenders page on page 17 for reference.

It is to be feared that some smart fellow will take advantage of the way CEN has decided to express the above margin. Indeed, still taking the example of the ISO 1600kg lift [ISO4190-1, now ISO 8100-30:2019] and supposing that a car with bare walls is acceptable, one can propose:

- *Either a 1600kg/21 pass. Using a smaller car (3.3m² versus 3.56) (see point (a) of Fig 7) and a smaller well,*
- *Or a 1750kg/23 pass. Using only the available 3.56 m² (see point (b) of Fig 7) but giving a higher traffic capacity.*

Reputable manufacturers will avoid using such tricks and consulting engineers and architects should discourage lift contractors from doing so. Competition on such bases leads to acrobatic designs and, ultimately, to lesser quality and lesser freedom for the architects.

The best way to avoid this problem is to use ISO standards. If, exceptionally, the ISO standards cannot be used, I suggest that the EN rule be interpreted in the following way: The number of passengers corresponding to a given area is given in the following tabulation (linked to the EN rule, Table 1.1); In line with the ISO standard, hand rails may be disregarded for the evaluation of the available area. Decorative panels may also be disregarded if their thickness does not exceed 30mm;

This number of passengers is to be used for the traffic calculation and may be indicated as a guide line on the name plate remembering however that the rated load, expressed in kg, is the leading indication and the only contractual one. Laboratory experience conducted in the States half a century ago [1935?] indicated that people could squeeze themselves into a car up to a 32% overload and that 42% could even be reached but I suspect that it needed some exterior help as in the Japanese subway. It was decided that the probability of exceeding 25% was so low that it was not worth considering.

Reckoning that an overload in the car means only a minor addition to the total suspended mass, the CEN philosophy is that the usual safety factors used in designing the machine elements and all structure can largely take care of that. There are 2 exceptions where this 25% had to be specifically introduced in the calculation: the brake and the traction. The CEN/TC10/WG1 is of the opinion that calling attention to the fact that the lift is designed for 25% overload would induce people to overload it systematically.

The extract has been abridged and the Figures 8 and 9 are not presented. The full article can be found: https://liftescalatorlibrary.org/paper_indexing/abstract_pages/00000518.html

Andre was concerned about "smart fellows" and "acrobatic designs". He suggests: either reducing the available car area and keeping the rated load the same and having a physically smaller lift; or keeping the same available area and increasing the rated load.

The Leenders figure at the start of this article is poor quality so I have redrawn it, but using rated load as the horizontal axis.

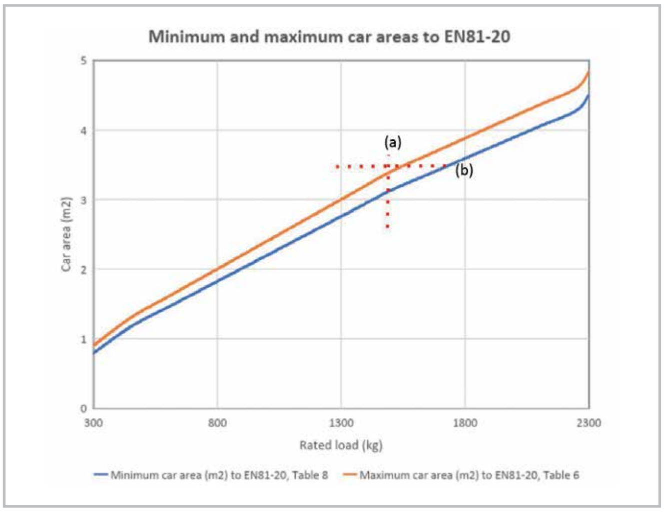


Figure A: Minimum and maximum car areas

Figure A shows for a fixed rated load (line (a)) the minimum and maximum available car areas permitted by the standards. It also shows, line (b) for a fixed available car area the minimum and maximum rated loads permitted by the standards.

Table B shows these values in tabular form. The 1600kg row refers to Leenders two propositions (a) and (b) also shown as dotted lines on Figure A.

Table B: Minimum and maximum car areas

Rated load (kg)	Maximum available car area to EN81-20:2020, Table 6 (m^2)	Minimum available car area to EN81-20:2020, Table 8 (m^2)
450	1.30	1.17
600	1.60	1.45
750	1.90	1.73
900	2.20	2.01
1050	2.50	2.29
1200	2.80	2.57
1350	3.10	2.85
1500	3.40	3.13
1600	**3.56**	**3.31**
1650	3.64	3.36
1800	3.88	3.59
1950	4.12	3.82
2100	4.36	4.05
2250	4.60	4.28
2400	4.84	4.51

Leenders makes a number of points:

1. That for a specific rated load the available car area has a minimum and a maximum value as shown in Table B. The advantage to a "smart fellow" is a smaller car (probably costing less to manufacture) and more space for the architect.

   The detriment is the reduction in the traffic handling capacity of the lift.

2. He draws attention to decorative panels or car finishes up to 30mm in thickness and suggests that this reduction in available space can be ignored. This cladding would affect very large lifts. For example, if a 2500kg lift had the minimum car area (4.66m^2) and 30mm of cladding it could result in a reduction in space equivalent to the space needed for over two 75kg persons. Similar reductions occur for small rated loads.

   The rated load is defined by the clear space of available car area.

   Note handrails should always be disregarded.

3. That the only contractual condition is the rated load.

   That and rated speed.

4. He explains the reason why tests on brakes and traction are carried out at 125% of rated load.

   See EN81-20:2020, 5.5.3 Rope traction:- Rope traction shall be such that: a) the car shall be maintained at floor level without slip when loaded to 125 % as per 5.4.2.1 or 5.4.2.2;

5. The remarks about squeezing passengers supports my proposal to revise Table 6.

6. The likelihood of a 25% overload being "not worth considering", again supporting my proposal to revise Table 6.

7. The remark to be able to overload lifts to 125% of rated load would not work today as we have load weighing systems which would prevent it. Particularly a lift is not going anywhere with an overload of more than 10%.

   See EN81-20:202, 5.12.1.2.2 The overload shall be detected at the latest when the rated load is exceeded by 10 % with a minimum of 75 kg.

DR GINA BARNEY PhD, MSc, BSC, CEng, FIEE, HonFCIBSE

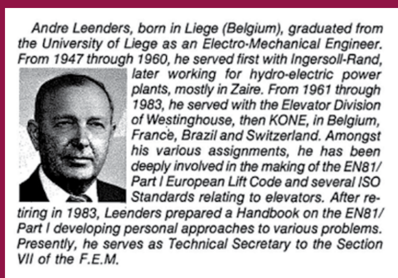
Gina Barney is well known to the world-wide lift industry, owing to her many activities in the field. She is Principal of Gina Barney Associates, Honorary English Editor of Elevatori, Member of the Chartered Institution of Building Services Engineers (CIBSE) Lifts Group Committee, Member of the British Standards Institution (BSI) MHE/4 Lift Committees, UK expert to two International Standards Organisation TC178/WG6 Traffic design and WG10 Energy efficiency of lifts and escalators.

Gina is the author of over 100 papers and is the author, co-author or editor of over 20 books (not all on lifts). Her main activities are technical writing of standards (she is a member of the Society of Authors). She has been Technical Editor of five editions of CIBSE Guide D Transportation systems in buildings 2000-2020. She is also a Member of the Academy of Experts and a Liveryman of the Worshipful Company of Engineers.

In the first From the Archives column in our July issue we asked if anyone had any more information about Andre Leenders

Jaakko Kalliomäki, Technical Product Owner, M.Sc., High-rise core technologies at the KONE Corporation replied to say Leenders used to work for KONE.

The 1989 May issue of Elevator World had a short CV of M. Leenders



Andre Leenders, born in Liege (Belgium), graduated from the University of Liege as an Electro-Mechanical Engineer. From 1947 through 1960, he served first with Ingersoll-Rand, later working for hydro-electric power plants, mostly in Zaire. From 1961 through 1983, he served with the Elevator Division of Westinghouse, then KONE, in Belgium, France, Brazil and Switzerland. Amongst his various assignments, he has been deeply involved in the making of the EN81/Part I European Lift Code and several ISO Standards relating to elevators. After retiring in 1983, Leenders prepared a Handbook on the EN81/Part I developing personal approaches to various problems. Presently, he serves as Technical Secretary to the Section VII of the F.E.M.

Jaakko reports: In 1978 – while we were in Brazil – he is included in a short distribution list of persons in a correspondence from Vilkko Virkkala, Vice President of Research & Development at KONE at that time. So we can presume he was an influential figure already at that time in KONE.

To me, he is by far best known for the EN 81-1 Handbook (and appendices!), which is still an invaluable source of information for those wanting to understand the rationales behind EN 81-1 (and subsequent lift standards).

John Simon, Board Member at KONE Corporation Centennial Foundation, who has extensively documented KONE history was able to add more detail.

I went carefully through KONE's digital archive. There were only two references for A. Leenders. He is shown, along with Philippe de Hepcée, as responsible for the KONE Westinghouse company in Belgium and its Liège Factory in 1975 and 1976 although de Hepcée died in 1976. There is no indication of the division of duties between the two, but one was apparently head of the company and the other head of the factory. I suspect, but do not know, that Leenders was responsible for factory and product and de Hepcée for the field operations. KONE built a new factory in Brazil at São Jose dos Campos in 1977, and if he was assigned there it was not as managing director but almost certainly to implement modern KONE production methods and perhaps serve as factory manager. The connection to Virkkala supports this assumption.

A big thank you to both Jaakko and John for their fantastic detective work, it is very much appreciated.

BEHIND THE SCENES AT LEIA

Intro from Nick Mellor, MD of LEIA

As we start a new year, it is good to reflect on 2022 as we plan for 2023. We begin the new year by welcoming a new LEIA president, Paul Turner, Technical Director at Schindler who takes over from Alastair Stannah, MD at Stannah. We would like to thank Alastair for his support and commitment to LEIA throughout 2022.

The autumn saw us deliver on some key objectives which reflect great credit to the LEIA Team who have worked towards these throughout the year:

- LIFTEX was driven to new highs by our exhibitors who notably included more LEIA contractor members. The increase in visitor numbers would have been good in any year but was exceptional in the context of other exhibitions post-Covid.
- LEIA Assessment delivered its first End-point Assessments of the Level 3 Lift and Escalator Electromechanic standard.
- LEIA Educational Trust has been accepted onto the Register of Apprenticeship Training Providers (RoATP), allowing it to offer apprentice training to the main providers. The Trust is now able to accept enrolments of apprentices from the main training providers.

Towards the end of last year, we held our second LEIA Technical Seminar which, along with updates on the latest EN 81 standards, evacuation lifts and the new EU Machinery Regulation, dealt with two important regulatory changes.

UKCA marking in Great Britain (England, Scotland and Wales)

- UKCA marking must be used where a UK Approved Body is used for conformity assessment – which will be the case for lifts as all new lifts require the involvement of an Approved Body. The UKCA mark may be on the lift or on accompanying documentation until 31 December 2027
- On 15 November, a two year extension was announced which will be of benefit for type examined lifts, safety components for lifts and machinery falling under the Supply of Machinery (Safety) Regulations allowing:

  - the continued recognition of CE-marking until 31 December 2024 – from 1 January 2025, the UKCA mark must be used;
  - the UKCA mark may be included on accompanying documentation or a label until 31 December 2027
  - UKCA marking based on conformity assessment activities for CE marking undertaken by 31 December 2024 to be used by manufacturers as the basis for UKCA marking, until the expiry of the certificate or until 31 December 2027, whichever is sooner
  - the previously announced easements for stock and for spare parts remain in place – safety components for lifts replacing safety components of existing lifts need only meet the requirements in place when the original part was installed.

- In Northern Ireland, the UKCA mark cannot be used as Northern Ireland continues to follow EU rules and so CE-marking must be used. Where a UK Approved Body is used for conformity assessment, the CE marking must be with the UKNI mark.

Fire Safety (England) Regulations 2022

The Regulations require responsible persons for high-rise residential buildings to carry out monthly routine checks of lifts for use of firefighters and evacuation lifts. LEIA is pleased to have worked with other industry stakeholders and has published guidance on the routine monthly checks. The guidance provides more general guidance to responsible persons on other standards and regulations, and identifying the types of lifts for use by firefighters and evacuation lifts they have in their buildings. There is more guidance on the LEIA website. ***https://www.leia.co.uk/publications/leia-newsletter/***

As an association, we are looking forward to the year ahead. That includes three planned seminars for members, welcoming new members and of course a couple of key industry events, which include The Lift Industry Cycling Challenge in July and the 14th Lift & Escalator Symposium on 20-21 September.

Membership and LIFTEX update from Oliver Greening, Senior Operations Manager

With National Apprenticeship Week coming up next month, we are continuing to promote careers in the industry through our Lift Careers site. There are so many inspiring stories from apprentices which are updated continuously. If you haven't had a chance to read them, I would urge you to. It's a great way to showcase the opportunities the industry offers young people. Plus, we have an employer section so that job seekers can find companies offering apprenticeships and take their first steps.
https://liftcareers.co.uk/

End point assessment update from Karen Slade, Head of End Point Assessment

LEIA's end point assessment service is in full flow as we carried out our first end-point assessments for the Lift and Escalator Electromechanic apprenticeship in Autumn.

We also received confirmation that our team of industry experts have now all achieved their assessment and/or quality assurance qualifications, which has taken a year to achieve. **Well done and thank you to the team for all their hard work**.

Our Level 2 Stairlift, Platform Lift, Service Lift Electromechanic standard is now looking forward to welcoming the first apprentices through for EPA any day now.

We gained Ofqual recognition at the start of last year and submitted our first state of compliance for Ofqual before Christmas.

We are also looking to expand our provision – keep your eyes peeled for more on that in the next issue.

As a reminder, our apprenticeships are:

LEVEL 2 - Stairlift, Platform Lift, Service Lift Electromechanic. There are six pathways for this apprenticeship:

- Stairlift installation skills
- Stairlift service and repair skills
- Lifting platform installation skills
- Lifting platform service and repair skills
- Service lift installation skills
- Service lift service and repair skills

LEVEL 3 - Lift & Escalator Electromechanic. There are four pathways:

- Installation of traction and hydraulic lift systems
- Installation of escalator/moving walk systems
- Servicing, repair and maintenance of lift systems
- Servicing, repair and maintenance of escalators/moving walks

Find out more at
https://www.leia-assessment.co.uk/

Distance learning and training update from Dan Charlesworth, Training & Safety Manager

The first cohort of distance learners for 2023 have started in earnest.

Over the past twelve months we've seen an increased number of enrollments on the courses.

We had previously assumed this was a Covid-trend, but we are pleased to say that the appetite for learning and development has continued beyond this.

The LEIA Distance Learning Course provides a technical training programme of study which aims to extend the candidate's knowledge of lift and escalator engineering. It has been designed by, and for, the lift and escalator industry to address the difficulties created by a highly mobile workforce and the demands of changing British and European standards requirements.

The course is divided into Full and Half units of study. The full units cover engineering principles, lift technology, electric traction lifts and hydraulic lifts. The half units cover lift and escalator technology, safety and commercial management.

The subjects available are:

- Introduction to Lift Technology (available as two half units below)
    - Basic Lift Technology
    - Complementary Basic Lift Technology
- Fundamentals of Lift Technology
- Advanced Lift Technology – Mechanical
- Advanced Lift Technology – Electrical
- Advanced Lift Technology – Hydraulic
- Electronic Systems and Controls for Lifts
- Management of a Lift/Escalator Contract – Part 1: Commercial
- Management of a Lift/Escalator Contract – Part 2: Site
- Escalators and Moving Walks
- IOSH Managing Safely for LEIA
- Stairlifts

https://www.leia.co.uk/education-and-training/leia-distance-learning-course/

SAFETY FIRST

SAFETY AND INSPECTION CONTROLS

Back in the day we didn't have car top controls but now it is rare to find a lift without one.

I am allowed to say "back in the day" as I felt distinctly old walking round LIFTEX and seeing my industry colleagues. I got the distinct impression I was keeping the average age in our industry up!!!!

Can't move on without saying how brilliant both the Symposium in Northampton and LIFTEX in London were. Great events and both well supported. Well done to LEIA for LIFTEX, clearly a great deal of work went into getting it organised. I can't say too much about the Symposium as I am part of the team that organises it but I would like to say that it is great working with such a bunch of dedicated people who are so invested in making our industry a great place to work.

When inspection controls became a requirement there was even a retrofit design which involved wiring the car top control such that the up button put a top floor call on in the car and taking your finger off the common button broke the safety circuit and brought the lift to a stop. The bottom floor car button was used for down travel. Hard to imagine you would get away with something like that these days but it meant that you could install a car top control on an existing lift without having to hang new trailing flexes.

In the modern world of course, we now have inspection controls in a multitude of places including the car top, pit, control panel and sometimes in the lift car itself if access to components is afforded by means such as lowering the lift car ceiling.

It is important that operatives working are safe at all times and recently we have become aware of inspection controls that can operate simultaneously in an unsafe manner.

In reality such circumstances are unlikely to be identified by a single operative undertaking maintenance as there would be no reason (other than by accident) to have more than one inspection control switched to inspection mode.

BS7255 (2012) "safe working on lifts" states in table G1:

Trained and untrained lift personnel and trained tradespersons (painters, electricians, plumbers, etc.) performing any activity in the pit area while repair activities are being conducted elsewhere above them, e.g. on the suspension or drive system. This combines invasive work with persons being exposed to falling or falling objects and is an AT4 activity, which needs to be avoided whenever possible.

Whilst it states "avoided whenever possible" there may be situations where it isn't possible to avoid it and therefore there is a risk that an operative on the car top or in the pit could try and move the lift car when another operative thinks they have exclusive use of their control station. Bear in mind that there may be more than two inspection controls installed.

EN81-20 5.12.1.5.1.1 states:

"to facilitate inspection and maintenance a readily operable inspection control station shall be permanently installed:

a. On the car roof (5.4.8 a)

b. In the pit (5.2.1.5.1 b)

c. In the car in the case of 5.2.6.4.3.4

d. On a platform in case of 5.2.6.4.5.6

Reference isn't made in this section to an inspection control at the control panel.

5.12.1.5.2.1 (i) of EN81-20 states:

"If more than one inspection control station is switched to "INSPECTION", it shall not be possible to move the car from any of them unless the same push buttons on the inspection control station are operated simultaneously"

In recent times we have seen this clause not being adhered to which raises the possibility of the lift car being moved without the consent of another operative which could create a hazardous situation.

The problem with testing the operation of the inspection controls is the number of permutations of switch position that need to be tested as you cannot simply rely on testing two at a time.

In the event that there are two inspection control stations the permutations are:

ICS1 POSITION	ICS2 POSITION	OUPUT POSITION
Inspection	Inspection	Lift car should only move when similar buttons are pushed simultaneously on ICS1 and ICS2
Inspection	Normal	Only ICS1 should be able to move the lift car
Normal	Inspection	Only ICS2 should be able to move the lift car
Normal	Normal	Neither ICS1 or ICS2 should be able to move the lift car but to be in this position an operative(s) should be protected by other means

In the event that there are three inspection control stations the permutations are:

ICS1 POSITION	ICS2 POSITION	ICS3 POSITION	OUPUT POSITION
Inspection	Inspection	Inspection	Lift car should only move when similar buttons are pushed simultaneously on ICS1, ICS2 and ICS3
Normal	Inspection	Inspection	Lift car should only move when similar buttons are pushed simultaneously on ICS2 and ICS3
Normal	Normal	Inspection	Only ICS3 should be able to move the lift car
Normal	Normal	Normal	ICS1, ICS2 nor ICS3 should be able to move the lift car but to be in this position an operative(s) should be protected by other means
Inspection	Inspection	Normal	Lift car should only move when similar buttons are pushed simultaneously on ICS1 and ICS2
Inspection	Normal	Inspection	Lift car should only move when similar buttons are pushed simultaneously on ICS1 and ICS3
Inspection	Normal	Normal	Only ICS1 should be able to move the lift car
Normal	Inspection	Normal	Only ICS2 should be able to move the lift car

It is absolutely essential that the correct function is checked during testing but perhaps periodic testing as a supplementary test could be considered given that we are aware that some control panels have been known not to fail safe when the controlling boards develop a fault.

Signing off for now and no apologies to every tester who is going to moan at me for highlighting the need for this process. Believe me, it is worth going through because if its not working correctly the possibility of movement could lie there in wait until some unsuspecting operative gets injured.

Stay safe out there.

BIOGRAPHY

EurIng Prof. David Cooper BSc (Hons), MSc, MPhil, CEng, FIET, FCIBSE, FSOE, FCGI,

David Cooper is the CEO of UK based lift consultants LECS (UK) Ltd. He has been in the lift & escalator industry since 1980 and is a well-known author and speaker. He holds a Master of Philosophy Degree following a 5-year research project into accidents on escalators, a Master of Science Degree in Lift Engineering as well as a Bachelor of Science Honours degree, Higher National Certificate and a Continuing Education Certificate in lift and escalator engineering.

He is a co-author of "The Elevator & Escalator Micropedia" (1997) and "Elevator & Escalator Accident Investigation & Litigation". (2002 & 2005) as well as being a contributor to a number of other books including five editions of CIBSE Guide D.

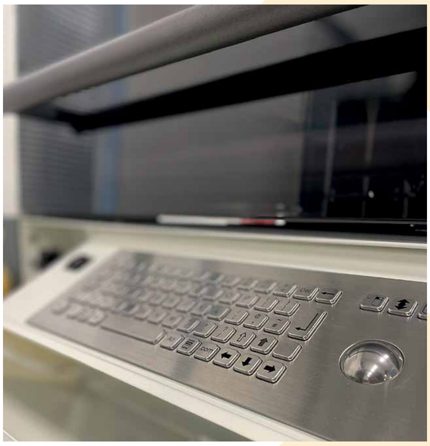
He is a regular columnist in trade journals worldwide including Elevation, Elevator World, Elevatori and Lift Industry News. He has presented at a number of industry seminars worldwide including in Thessaloniki, Munich, Shanghai, San Francisco, Melbourne, Zurich, Barcelona and Vienna as well as numerous presentations within the UK.

He is also a Founding Trustee and Chairman of the UK's Lift Industry Charity which assists industry members and/or their families after an accident at work. In 2012 David was awarded the silver medal by CIBSE for services to the Institution. David also Chairs the Charity that runs the Lift Symposium and is an Honorary Visiting Professor at The University of Northampton.

He also sits on the Board of CIBSE. In 2021 he was awarded the Sir Moir Lockhead Award by the SOE for 30 years dedication to safety in the lift & escalator industry.

THE INTERVIEW

SafeLine has been manufacturing safety accessories for lifts for over 25 years. With over 100 employees (or 'SafeLiners') and representatives in over 25 countries, they are focused on producing high quality products, tailored specifically for the lift industry. We chatted with CEO of UK and Ireland, Stuart Garcia about their vision, values and what the future holds for SafeLine.



Tell me a little bit about the history of SafeLine

SafeLine was founded in 1995 by lift engineer, Lars Gustafsson. It was a family run business for many years before Lars happened to meet a telephone engineer when answering an advertisement for an emulator, and together they developed their first lift telephone in 1999. We're now an independent lift safety company with offices all over Europe. We are the largest independent manufacturer specialising in lift safety, with over 300,000 installed lift telephones. Even though we're not a traditional family-run business anymore, we've won awards for how we look after our staff, and the feel of family is still very much there.

How do you operate as a workforce, spread so far apart?

We opened our UK office in 2019, and I was working on my own for a while. You quickly realise that you can't run a business on your own, and you have to employ people better than youself! Our staff are the heartbeat of our company, all over Europe, we're very close, meeting up every other month in person to keep that contact and connection, making sure we visit each office. We have summer parties and Christmas parties to make sure we keep face to face a top priority.

Why is your motto "For lift people, by lift people" so important to you?

The business was started by a lift engineer, and there are so many people within the company who are lift engineers, including myself. We've had hands on experience - we know what the industry needs, and we produce solutions that solve those issues. We're not just a tech company making a product for a specific sector, we are in the industry, we have a deep understanding of the real needs and requirements. This means our work and support have that personal touch and we have a quicker, real-life comprehension of a variety of situations.

Your vision is "Communication experts keeping you safe, today and tomorrow". How important is that focus on communication for you?

There's a real need for upgrading communication in the industry, due to the 2025 digital switchover. Scandinavia is well ahead in GSM technology, so we've found ourselves moving ahead faster, with the introduction of 4G VOLTE – it's been a gamechanger for the lift industry and GSM mobile communications. The other major issue is, alongside losing the analogue telephone lines, we're looking at losing 2G and 3G fairly soon as well. All products using analogue, 2G and 3G will start to disappear, which hasn't been well communicated. There's a lot of misconception that you can switch from PSTN to a GSM, and many are switching to 2G which will disappear in a few years. It's so important that we help our customers futureproof their systems by recommending 4G VOLTE instead.

What are SafeLine's long-term plans?

In the long term, we are developing our own product to focus on Smart Elevators, using IoT and AI technology to predict future faults and failures in a lift as well as predictive maintenance. We collaborated with the Royal Institute of Technology in Stockholm, gave them the problem that needed solving and they came up with the solution. The professor who oversaw that is now on our development team. There is a growing interest in this and we're also getting a lot of enquiries about improving sustainability, reducing CO_2 footprints by using smart technology. It's where we see our future, helping sustainability and reducing carbon footprints by installing smart devices. In turn this will improve reliability and reduce costs.

The industry skillset is quite low at the moment, so any information that helps the onsite teams can only improve service. Our UK office has only been operating for a few years, but as we grow, taking on apprentices and training up engineers is a high priority for us.

You're a Swedish company – why is having a UK base important? Are you anywhere else across the world? Any plans for global domination?

The UK market is unique, very different to the rest of Europe; we have a high priority on fire evacuation communications compared with the rest of Europe, and the UK market is much more demanding – it's about quality over price here. The UK is our number one market outside Europe.

What does being a SafeLiner mean?

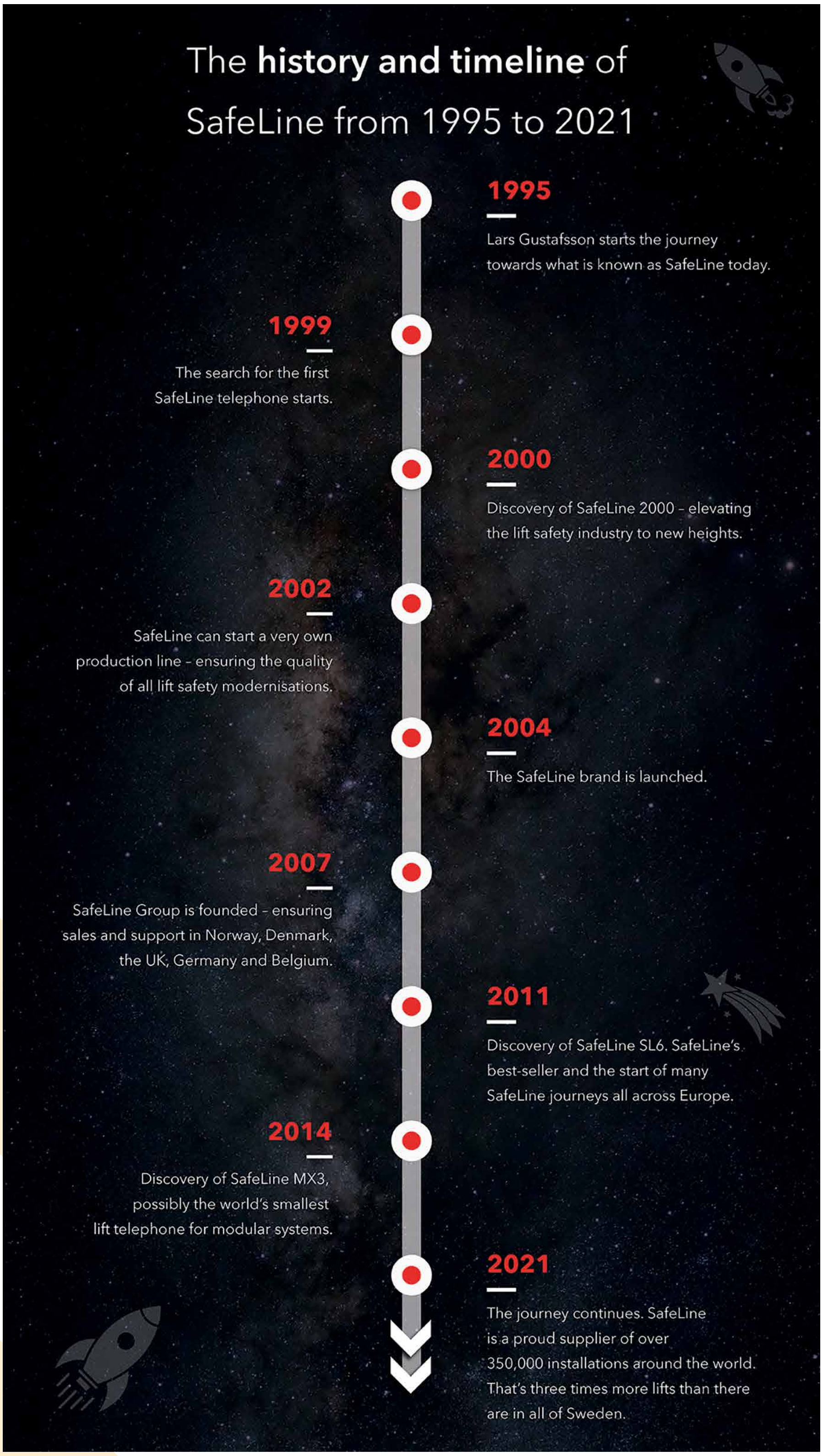
We say you're a SafeLiner once you've met everyone – you're part of the family very quickly. As soon as you join the company, we make it a priority to send people out to Sweden, meet the other offices and meet everyone. SafeLine is very much a family-orientated business – there's no hierarchy, you wouldn't know who the boss is! Everyone knows everything, there are no hidden agendas, we update the intranet daily and we make it really easy to interact with each other.

Is there a specific project that you are particularly proud of?

We've been prevalent in the UK for a while now, through using distributors, but our offices are relatively new. Last year we completed a project for a large university on the south coast to install nearly 100 lift telephones and evacuation units on every lift. We completed that on time and to budget, and that's opened up avenues in other universities. We've since completed work in nine universities in the UK. We're really proud of that project, how well it was managed and completed, and now the original university has asked us to install LYRA and ORION devices to make their lifts smart lifts.

What's next? What are your top priorities for the company?

The digital switchover, of course, is a top priority and we're growing the company, looking to open an office in the north. We've also just installed another production line in Sweden which should increase our output by 30%. This means we should have a much more stable, constant supply of products in the UK, so we'll be able to supply our customers consistently with smart lifts and for the digital switchover.



To find out more about the company, visit their website - https://www.safeline-group.com/en/

LIFTEX 2022 RETURNS AS BIGGEST YET

LIFTEX 2022 was the biggest yet in its 34 year history. The tri-annual trade show organised by LEIA took place in October at London's ExCeL, having been postponed from its usual May spot due to the pandemic. The 34th edition saw a 22% increase in attendance with over 4,000 attendees across the two days.

The show floor was buzzing throughout, and visitors had the opportunity to meet over 100 exhibitors from 12 different countries including the UK, Croatia, Germany, Italy, Spain, Sweden, Switzerland and the USA.

Reflecting on the event, **Oliver Greening, LIFTEX Show Director,** commented, **"We are delighted with the success of this year's show, and it was great to see the industry reconvene under one roof once again. This was the first time we've had a breadth of industry representation from contractors, service companies, component suppliers and organisations from support services. This included hosting the major players Schindler, Otis and TKE for the first time and welcoming back Wittur after a short break. The overwhelming message from visitors and exhibitors alike is that LIFTEX plays a vital role in supporting the UK lift and escalator industry. Many we spoke to told us they couldn't miss it for that very reason."**

As ever, the free seminar programme proved a popular draw. On Day One, **Dave Searle**, Member, LEIA Technical Committee and Deputy Chairman of MHE/4, BSI Committee for Lifts, Hoists and Escalators and BSI delegate to CEN, looked at the revision of the EN 81-20 and EN 81 family designated standards to a standing-room only audience.

Nick Mellor, MD at LEIA offered insight into evacuation lifts, fire and disabled residents, stressing the importance of knowing the lift type for the fire risk assessment of a building.

Matthew Davies, Head of Strategic Marketing - Europe, AVIRE and LEIA representative, European Lift Association TELCO Working Group, updated the audience on the impact of digital telephone lines on lift alarms. With an estimated two-thirds of all lift alarms in the UK connected to telephone landlines due to be withdrawn by the end of 2025, the digital switch represents a seismic shift in the telecoms infrastructure in the UK. This change will have a fundamental impact on the operation and resilience of lift alarm systems. In his session, Matthew highlighted the risks of proposed fibre solutions which are not planned to be battery-backed as standard, key questions liftowners need to be asking, the rapidly increasing pace of the fibre roll out and the available solutions which can ensure lift alarms always remain available.

Many lift owners are switching to 4G GSM solutions (2G mobile is also expected to be withdrawn in the next few years).

On the second day, **Matthew Canham**, Fire Safety Engineer, National Fire Chiefs Council Protection Policy and Reform unit (PPRU) Building Safety Programme (BSP) discussed lifts for use of the Fire & Rescue Service.

Paul Clifton presented on the UKCA Marking introduced post-Brexit. He addressed many of the questions that have arisen with the introduction of the new legislation and gave an overview of the current position.

The London Plan and evacuation lifts was covered by **Adam J Scott**, CIBSE Lifts Group Chair and Codes & Standards representative. In his presentation, Adam explored these requirements both from a technical perspective and, perhaps as importantly, from a scope of works and stakeholder responsibility perspective. Both days rounded off with a panel discussion.

The presentations from the seminars can be seen here: *https://www.liftexshow.com/seminar-programme/*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LIFTEX 2022 THOUGHTS ON SEMINARS

A number of the topics covered at LIFTEX are discussed elsewhere in this edition. Here Nick Mellor reflects on two areas of great importance to our industry where things have moved on since LIFTEX.

While recent changes with the requirements for UKCA marking and fire safety are covered in "Behind the Scenes at LEIA", here we look at some issues underlying:

- the relationship between UK regulations and EU legislation which underlies UKCA-marking
- the new Building Safety Act and other fire safety legislation.

Post-Brexit, we at LEIA have joined with a wide range of industry groups to seek a more workable UKCA marking regime with the UK Government. These efforts, spearheaded by key lift industry players, have resulted in two extensions and one set of 'easements'. LEIA is actively involved in working with the UK Government on a longer term conformity marking regime and on the key issue of the future of the regulations of interest to our sector.

At present, the UK regulations for lifts and machinery are part of 'retained EU legislation' which was decoupled from EU directives and established independently in UK law from 1 January 2021 but with identical technical requirements.

It is because the technical requirements of CE-marked and UKCA-marked equipment are aligned that the recent extensions and easements could be made. How long will this remain the case and what would be the implications of diverging?

The Essential Health and Safety Requirements (EHSRs) of new equipment regulations such as the Lifts Regulations, the Supply of Machinery (Safety) Regulations, and the EMC Regulations, were established to provide a common level of safety for new equipment to underpin free movement of goods in the EU.

These EHSRs are supported by EU harmonised standards and UK designated standards; following these confers a "presumption of conformity" to the relevant EHSRs. Designated standards remain voluntary in their application.

Longer term, UKCA marking might be useful if UK regulations diverge from EU technical requirements. For the regulations of interest to our sector, LEIA continues to argue strongly that the UK should remain aligned with the technical requirements of EU legislation. Two of our 'watch points' on this are:

- The expected publication of the UK Government's consultation on product safety.
- The UK Government's position on alignment with the EU Machinery Regulation expected to be published early in 2023.

The EU Machinery regulation will be important to us for a number of reasons:

- New Essential Health and Safety Requirements (EHSRs) including for new technology will feed through into harmonised standards for machinery (including escalator and moving walks and lifting appliances), then into UK designated standards, and will also have an influence on lift standards.
- Many UK companies export lifting appliances to the EU will need to meet the new requirements.
- Significant alterations for machinery are likely to be brought more into the scope of the Regulation with its potential implications for modernisation of machinery and lifts.

At the standards level BSI, which continues to be a full member of the European standardisation bodies such as CEN, is committed to publishing ENs as BS ENs. Potential divergence in EHSRs could be handled in a BS EN standard for example through the addition of a National Annex.

Building and fire safety was a main theme of the LIFTEX seminars. The Building Safety Act, its many pieces of secondary legislation, and other changes in fire safety regulations and standards are starting to have a profound impact on our industry.

The Building Safety Act enacts the recommendations made by Dame Judith Hackitt in her 2018 report "Building a Safer Future" with its intention to change the culture of construction. The Act obtained its Royal Assent in April 2022 and, with a raft of secondary legislation, introduces:

- the new Building Safety Regulator (BSR) within the HSE
- a new regulatory regime for higher risk buildings (HRBs) which are at least 18 m height/ 7 storeys with at least 2 residential units
- a new dutyholder regime for clients, principal designers, designers, principle contractors and contractors
- new competency requirements
- new 3-stage gateway scheme
- a new regime to oversee and manage safety in HRBs.

The Building Safety Act's application is far wider than high-rise residential buildings.

While it might appear that much of this is targeted at HRBs, which the Government estimates to be around 12.500 in number, the Act has requirements which apply to all buildings:

- competence requirements which the BSR will oversee;
- although the BSR will have responsibilities for higher-risk buildings, its remit will be across all buildings.

What might all this mean for the lift industry?

Competence of many in the sector will come under new requirements for competence such as:

- those undertaking elements of building design such as consultants specifying the number and location of firefighters lifts and evacuation lifts, especially the size and number of evacuation lifts to evacuate a given number of people in a an acceptable time;
- designers where their design impacts on the building regulations - either for new build or for refurbishment work;
- installers, maintainers and testers responsible for the ensuring the work is in conformity with requirements;
- those carrying out checks to verify the type of lift for use by firefighters (e.g. firemen's lifts, firefighting lifts and firefighters lifts) or evacuation lifts and verifying their correct operation.

For many years, the lift industry has provided firefighters lifts (and before that the firefighting lifts) so important to firefighters in high-rise buildings. The maintenance and inspection of of these to ensure the correct operation and availability will also come into sharper focus.

There are several areas of work underway looking at the future use of lifts for evacuation of and by disabled people: the London Plan featured elsewhere in this edition; revision of BS 9991 code of practice on Fire safety in the design, management and use of residential buildings; development of a European standard for lifts for the evacuation of disabled people which would be published as EN 81-76; research work underpinning a revision of Approved Document B of the building regulations; and in due course a report by the BSR mandated by the Building Safety Act.

In the near future, we are likely to see significant changes in the specification of when and how many evacuation lifts a building should have and of the requirements for those evacuation lifts. These will have new features and control methods very much more sophisticated than the basic type of evacuation lift we have had for more than 30 years. The lift industry, clients, consultants and designers will need to respond.


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LIFTEX 2022 EDITOR'S OVERVIEW

LIFTEX was a great few days for us at Lift Industry News. We met so many people, reconnected with old friends and made new ones.

I was very impressed with the effort the exhibitors had gone to in creating entertainment on their stands. The last trade show I had worked at Excel was a Toy Fair so Peppa Pig and various Marvel superheroes were walking around. I did not expect a close up magician, a golf driving range, mini golf or a fairground grabber at an exhibition all about lifts!

International magician, Etienne Pradier, was on the Syntium stand. With 15 Years in the Magic Circle, Etienne has performed in front of the Royal Family and beat world famous magicians Penn and Teller at their own game. He lured us onto the stand with immense charm and close up magic, pulling cards out of thin air, coins vanished and reappeared

and effortlessly removing a watch with the owner not realising. Hugely entertaining and surely a conversation starter for Dave O'Brien and the team at Syntium.

The Kapok 88 stand cleverly used their own protective drapes to crate a driving range where you could take on PGA professional Ben Hall to see who could get nearest the pin. A constant stream of visitors tried their luck only to be shown up by the MD of Kapok, Richard Annable's young son!

Golf is obviously a big draw in the lift industry and Universal Lifting Hire services had a tricky mini golf game – where points meant prizes. Congratulations Jamie Shelley at Otis Elevator Co. for winning the first-place prize! Team Lift Industry News did not cover themselves in glory…

On the Jackson stand, popular end of the pier games were available and a life time wish was granted – I won a bear on the grabber machine. OK, full disclosure, I nearly won a bear but it slipped out of the claws just as it reached the hopper and the lovely Phil Rudd gave me a bear as a consolation prize!

And the LIN team vote for best giveaway - Shorts water bottle because it says LIFT professional on it!

Thank you LEIA, the organising team and all the exhibitors and visitors at LIFTEX for a fantastic couple of days, see you in 2025!

A LIFE IN THE DAY

Nancy Lycett is the Managing Director of ILE (International Lift Equipment) – a company her father set up in 1976, remaining a family-run business since then. Based in London, Leicester and Keighley, the business today employs 98 people and serves a wide range of commercial and public sector clients with fit-for-purpose lift equipment.

As a female industry leader, Nancy recognises the importance of having role models – and being one.

THE ACCIDENTAL MANAGER

For most of her early working life, Nancy had no appetite to join the family operation. She enjoyed a successful career as a Chartered Surveyor and eventually transitioned into the world of education. In the late 1990s she was teaching English in a Newham boys' school, when her father was unexpectedly diagnosed with early onset Alzheimer's Disease. In January of 2000, she decided to take a temporary step back from teaching to help the business.

"I didn't enter the business with a view to running it," Nancy clarifies. "I simply wanted to support my family and ILE through a difficult time." However, as her father's health deteriorated, Nancy found herself becoming more immersed in the day-to-day operations. The one year she'd committed to ILE soon became two, three, and five. Initially her role was a hybrid: running accounts and helping out on the property side. However, soon she was also able to take on a human resources role and put a number of transferable skills from the world of teaching to good use in the business. "Sales was really the last part of the business that I got involved in," she says, "as it required an understanding of the technology. I had academic qualifications, but I knew virtually nothing about lifts." She spent time learning from people like John Miller and Dave Dixon in ILE's Leicester manufacturing facility, who became her early mentors. "It's funny – I always felt like it would be a huge learning curve," she says. "But now I can see that the essential technology is quite intuitive."

ROLE MODELS IN A CHANGING INDUSTRY

As a female industry leader, Nancy recognises the importance of having role models – and being one. "On the supply side, there have always been powerful women in the industry," she says and mentions names such as Gina Barney of Gina Barney Associates, Ann Warren of A&A, and Helen Roberts of Global One. The bigger challenge, she argues, plays out in the service and installation world.

"The perception, and perhaps the reality, has always been that installing a lift is an incredibly physical job. Women historically were not even entertained as a potential fit for this type of work. But the arrival of the MRL product has helped to change the landscape. With the standardisation of the product, and the value engineering to make it lighter, we're seeing more young women get involved in service and even installation." Nancy describes ILE's new lift system, Nimbus, as an example of a great opportunity for the business to increase its percentage of female employees thanks to the focus on electronics and digital technology over heavy-duty manufacturing, welding, and lifting.

The technology of lifts, Nancy points out, in itself presents few barriers to women. "You're dealing with a mechanical package using an electronic control system. Electronics are studied in secondary, further and higher education by all students. As young girls are taking those classes, it opens up a world of opportunities in the lift industry as they have the requisite qualifications. The challenge for teachers is to get more young women involved and interested in STEM topics at higher levels of study." As a school governor, Nancy actively discusses this topic with great passion as she helps the school highlight options and advises young people on future career opportunities.

RECOGNISING UNIQUE STRENGTHS AND CHALLENGES

Nancy sees how organisations are starting to recognise that it's not all about physical strength anymore. "Strength has many faces," she says. "There's emotional strength, social strength, resilience, flexibility. We never used to talk about emotional intelligence when I started work, even though we may all have relied on it. It was never valued or recognised. Today, we have the opportunity to change that."

Being a female-led business, Nancy admits that ILE perhaps is more likely to be conscious of the work-life challenges that typically impact women, compared to other employers. She has hired and promoted several women into key positions in the business and helped them manage the puzzle of family and work. "We want to make sure that the individual's needs are met, while they work to their strengths," she explains. For Nancy, this means investing in her employees, while also helping them confidently to make the most of career possibilities presented to them within the company. "There's no 'job for life' anymore. We need to allow people to see a future, and to see a transition pathway into new roles."

Nancy shares the perfect example in the form of one of her team members. "Stevie is a woman who worked for us as a cleaner in Leicester for about eight years. When she started work at ILE she had two young children, and sought work that she could fit in around the school drop-off and pick-up. Now, her youngsters are 9 and 13 and she is on a new career pathway in Leicester PCB and repairs sales' desk – and she's making great progress. I believe that she always knew she had further potential, she just wanted to prioritise her children. This role gives her new opportunities, and benefits ILE as she is a very bright woman."

When it comes to training and personal development, ILE actively supports colleagues wanting to further their education. "We run our internal training," Nancy says, "but we also facilitate training through Northampton University and LITS for those who want to continue learning. We are absolutely committed to training our employees, and to passing on skills from the older generations to the younger."

BUILDING THE WORKFORCE OF TOMORROW

Nancy employs several apprentices in the company and has done so for many years – A number of them have stayed on with the business beyond their initial training. Still, she describes it as a roll of the dice. "Young people have to make decisions ever so early – and these jobs are not for everyone. Manufacturing is a tough environment and sometimes our apprentices want to explore different ways to earn money. But if you have them for a while, even just the period of the apprenticeship, at least you have the opportunity to show them what they are capable of."

Walking in her mum's footsteps, Nancy is today seeing the many rewards of being a woman-led business. With female leaders on the factory floor and in the board room, there is simply no space for a 'machismo culture', sexism, or discrimination. While she admits there is work to be done in terms of building a more diverse workforce, Nancy is confident that the future belongs to the modern, flexible, and adaptable business that gives everyone an opportunity to shine.


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A LIFE IN THE DAY

Gemma Moore is Regional Account Manager for the Midlands and the North at Dewhurst UK, and is a familiar face for many LinkedIn users thanks to her engaging, interesting, and often hilarious posts. An army veteran, she also happens to be a semi elite runner who occasionally competes at 10ks and Half marathons alongside Olympic champions.

She'd always had a mechanical mind, wanting to explore how things work – even as a child, sitting with her father who was a video engineer.

LIFE BEYOND THE MILITARY

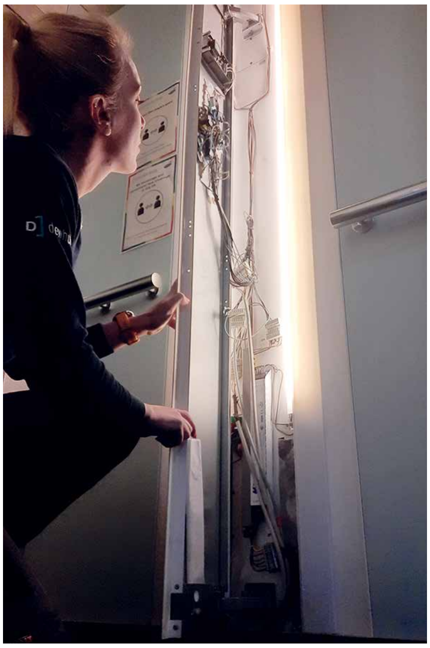
Gemma joined the army when she was 16 and served for 12 years. She quickly became used to working in a male dominated environment and enjoyed the experience of being part of a hands-on, hardworking team. She'd always had a mechanical mind, wanting to explore how things work – even as a child, sitting with her father who was a video engineer.

Leaving the army and settling into a regular job as a civilian can sometimes be a challenge, but Gemma made the transition with the support of a former military boss who invited her to apply for a Sales Support Executive job with Otis in Newcastle. She was instantly hooked.

"I loved the industry from day one," she says, "but I didn't enjoy the admin side of things. I wanted to be out there in the field, in the thick of it. So I asked to get my hands dirty, and the engineers were fantastic. When I was doing quotes and drawing up contracts, they'd let me come out to see these lifts – some of which the public would never even get to see. I loved it."

A CURIOUS MIND AT WORK

After a few years pursuing other career tracks, Gemma returned to the industry by joining Stannah Lifts where she started doing repairs quotations for industrial lifts. Here, she focused on getting her qualifications, and again took every opportunity to go out on site to see the equipment. "I wanted to see the stuff I was quoting on. If I ever got a request for a rope change or a load beam test, I wanted to know what everything looked like and how the tests and repairs are carried out."



Gemma describes having helpful and supportive colleagues at every stage. "I've always had a good network of guys that I can call if I'm stuck with something. But the amazing thing is that these guys are now ringing me to ask me technical specific questions about buttons and indicators. I love the fact that I'm respected and trusted because of my product knowledge and my experience." Today, Gemma is undergoing LEIA training and wants to continue her learning journey even further. "The more you've got in your back pocket, the more people respect you because they can see that you are in it for the long run."

THE UNIQUE FEMALE STRENGTHS

There are many scenarios where Gemma sees that being a female offers a distinct advantage and brings value to the business. "Apart from multi-tasking, which we often talk about, the one thing that women do is that we listen differently. I get a better engagement with customers, simply because I'm listening. I take in information beyond what they're saying, I listen actively and pick up on the subtleties that allow me to serve them in the best way, making the customer feel heard and understood." Gemma sees how this skill often holds the key to better problem-solving. "Nearly all my customers are men. They know what they want to achieve, but they don't always know what the solution looks like. Active listening allows me to get between the gaps and understand what they need. Men do of course listen too, but I think at its core it is a feminine skill that often comes very naturally to women."

While Gemma is proud to have her distinct female traits and skills, she is careful to not play into the expectations of what women should be or look like. "I'm not an Instagram girl," she says. "I'm not there to make a picture look pretty. I'm not worried about my hair or my nails – I literally get my hands dirty. I've crawled around on some filthy lift floors and climbed in pits with water puddling on the floor, but I'm not bothered. I just get on with the job." Gemma only knows a handful of female engineers, and although she sees more female apprentices coming into the industry – they typically don't seem to go any further. "I honestly don't know why that happens," she says. "Why aren't they continuing? I see male apprentices who keep going and end up in bigger roles down the line. But when it comes to the women, they just seem to drop off that journey. We need to try and find out why they're leaving and how we can support them to continue. I'd love to see more women out in the field," Gemma says and describes how she looks forward to the day she turns up to a site and is greeted by a female engineer. And, true to form, she guarantees she'll take a photo and post it on LinkedIn.

A LIFE IN THE DAY

Carey Oakes is Operations Director at Knowsley Lift Services, a full-service lift company based in Liverpool. Apart from boasting an impressive industry career journey, Carey is also known as the UK's first female lift engineer apprentice.

At age 16, however, Carey happened to land herself an interview for Otis. She was the last of 90 candidates to be interviewed, and the only girl.

THE BIG GAMBLE

From a very early age, Carey remembers having an unstoppable curiosity and a drive to explore how things worked. As a child she would build Meccano sets and occasionally drive her parents up the wall by taking the radio apart and putting it back together. However, after leaving school she didn't quite know what to do. All she knew was that she had an interest in engineering. At age 16, however, Carey happened to land herself an interview for Otis. She was the last of 90 candidates to be interviewed, and the only girl. "Otis called my parents," Carey remembers.

"They explained that they were prepared to take a big gamble on me, as I would be the first female apprentice they'd hired. They wanted to find out how my parents felt about me going into such a heavily male dominated environment. And my mum and dad just said, 'if that's what she wants to do, she'll do it.'"

The gamble paid off, as Carey soon qualified as an engineer and stayed with Otis for 10 years. From there, she moved on to Schindler where she was promoted to lead engineer followed by technician, before going into a management position. For a few years, she took a different direction and went into consultancy, but eventually returned to Schindler where she was instrumental in developing their escalator division for Network Rail. She eventually landed at Knowsley in 2019.

THE POWER OF SUPPORT

32 years after those first few steps into the industry, Carey reflects on her journey. "I'm very lucky to have been given the opportunities that I have, but I have also worked hard for it. I've had to prove myself more than my male counterparts. It's been tough, but I've enjoyed it at the same time. And I'd like to think that my career is an example of what can be achieved, she says. Everything I set out to do, I have done."

In all the roles she's had over the years, Carey has never experienced any chauvinism or favouritism directed towards her. She has always felt supported and doesn't believe she would have stayed in the job this long if she'd experienced any discrimination. Having said that, she has seen sexism at work. She recalls one situation where a male engineer wanted to 'opt out' of working with a female engineer. "It genuinely baffled me, and I challenged him on it. Seriously, what's the difference?" It turned out that the individual didn't so much have a problem with the situation himself, but worried about what his colleagues would say. It was more about perception than principle. "We're not talking about an agenda here," Carey continues. "We're talking about people. People who are qualified in their own right, who have the education, and have worked hard to get to where they are. They deserve a place – we all do."

ENCOURAGING STEM FOR GIRLS

Carey is passionate about getting young women into the industry and would love to be a role model for young people looking for a track into the world of engineering, like she once did. Recent research indicates that 35% of STEM students in higher education in the UK are women, but at graduate level that number drops to 26% - and out of the whole engineer workforce, only 12% are women. "Somewhere along the way, we're losing the girls," Carey says. "I don't know whether that's because there isn't enough promotion at that level, or we just don't have enough role models out there." Carey wishes there were more people like herself who could get out to schools and colleges to speak to students when they go through their A-levels and start thinking about further education or career options. "It would make a big difference, because with good role models, you're more likely to see yourself doing these jobs."

Today, Carey has reached a point where she's fully confident in her own ability and doesn't feel dependent on other people's support, but she would love to get more opportunities to extend that same support to other young people entering the industry – and help remove the impression that the lift industry is a man's world: "Hiring a woman should never be seen as a gamble."

Lift Industry News is grateful to Asa Magnusson for interviewing Nancy, Gemma and Carey

BIOGRAPHY

Åsa Christina Magnusson Content Director at UK-based marketing agency Curzon Creative. She is an accomplished marketing professional with a solid background in technology and manufacturing, specializing in quality content creation. She is the author of the 2022 AEG white paper RISE – the Untapped Potential of Women in the Elevator Industry.

A LIFE IN THE DAY

LJ Stocks talked to Gemma Greenway, Business Manager at AVIRE, whose products are installed in over four million buildings worldwide.

I haven't experienced any prejudices, being a woman in the industry.

HOW DID YOU GET STARTED IN THE INDUSTRY?
I was head hunted by a recruiter, I had never considered a career in the lift industry, it's quite a hidden industry that's not well known. Considering how ingrained lifts are in everyday life, it's a surprise more people don't think of working in the lift industry!

WHAT HAS YOUR EXPERIENCE BEEN IN TERMS OF FEMALE REPRESENTATION AND ATTITUDES IN THE INDUSTRY?
I haven't experienced any prejudices, being a woman in the industry. At AVIRE, our core values are around collaboration and inclusion, and we have a fair representation across the whole business.

I haven't seen anything that sits outside of a normal engineering or manufacturing industry. It's still quite a male dominated industry, but I imagine this has shifted, and continues to with the increase of female leaders.

I also think as the industry embraces digital, that will naturally bring a more diverse workforce. For example, I am currently developing a new solution, SENTINEL, to help lift owners transition through the digital switch while ensuring they remain compliant and continue to provide safety for their passengers. By leading this initiative, I am involving a diverse team with a broad skillset to ensure we address the different needs

to ensure the solution is resilient, user-friendly and cost-efficient. I am currently working with Engineers, UX designers, Software developers, finance, sales and customer success to name a few teams.

I think engineering as a whole needs to do more to bring females into this space and make it welcoming. Also, as a woman, I would probably advise comfortable footwear, rather than heels at a lift exhibition!

HOW DO YOU THINK WE CAN INCREASE FEMALE REPRESENTATION IN THE INDUSTRY?

Getting in early with younger girls is important. A good example of where I've seen this work is at a previous company I worked for, we went into schools and did workshops. We always made sure there was a mix of female and male representation going in to lead the training. It was key for young people to see people like them in those roles.

There's a lot of visual language around engineering – heavy manufacturing and big processes – they don't always convey the more female-oriented side of haptics, design and delivering user experiences. We need to make sure we are conveying all of that.

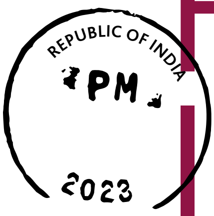
HOW DO YOU THINK WE CAN SUPPORT YOUNG PEOPLE TO ENCOURAGE THEM INTO THE LIFT INDUSTRY?

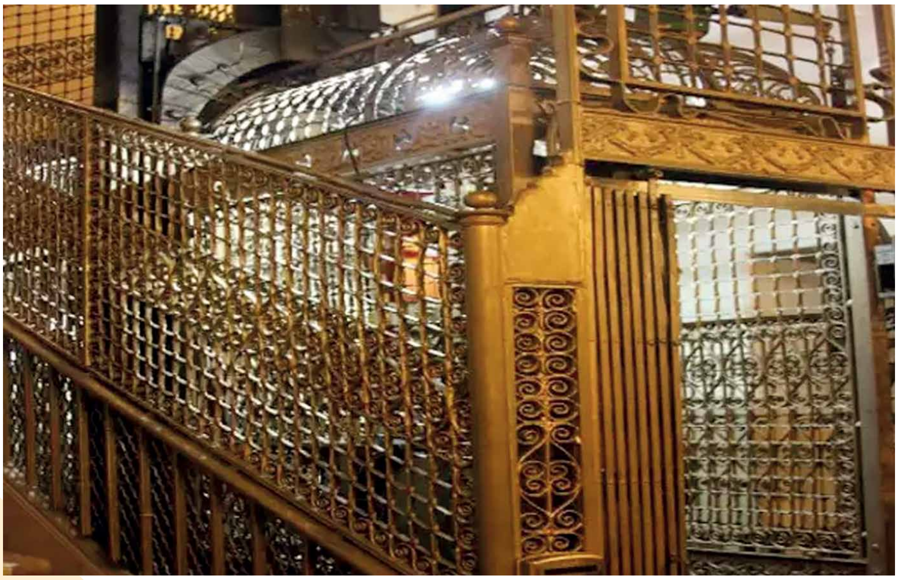
We need to make it less hidden. We need to engage at all ages, getting into schools and running sessions and opening up the world of the lift industry to the people that use it. Kids are so excited about getting into lifts and pushing buttons – it's about harnessing that excitement of playing and moving things and showing them the range of roles, from office-based to engineering, to being on the road fixing things, customer relationship management, sales. It's not just about a man in a van fixing things, there's a much wider business that supports it.

WHAT ACTION CAN COMPANIES TAKE TO IMPROVE EQUALITY AND DIVERSITY?

As the industry moves into a more digital space and follows the communication sector through all of the changes going on, I think we will naturally gravitate and shift to have a more diverse workforce. At AVIRE we are fortunate that it's part of our DNA that we drive diversity and training through all our teams. We have a very safe space where we can speak freely and be listened to. The industry is quite conservative, which I think is a risk – I think maybe it needs to get out of its own way – we do what we've done for the past 40 years and everyone knows everyone, which can be quite intimidating. It needs to flip to have a growth mindset and embrace change and challenge ourselves on why we do things, which will open up the diversity of thought and start a culture shift.

LETTER FROM INDIA





The Indian Lift Market
TAK Mathews

India's first lift as per verifiable records was installed in 1892 at the Raj Bhavan, Calcutta.

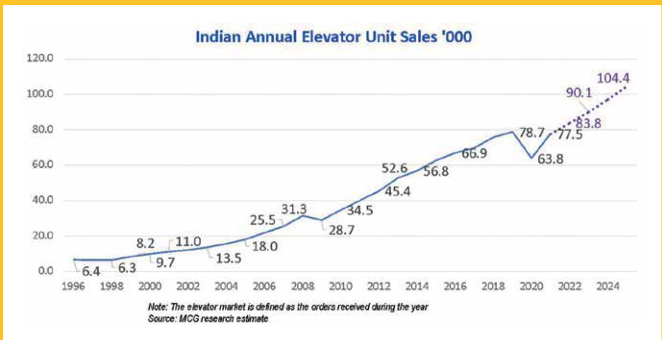
A newspaper report from a few years back states that this lift has been modernised only twice – once in 1969 and a second time in 2010, perhaps an indication of the sturdiness and robustness of lift design and construction of yesteryears.

For most of the last century, lifts were still considered a luxury and the market growth was reflective of this trend. The growth remained pedestrian and was monopolised by Otis.

THE MARKET

At the turn of the century, the situation changed. Even if not at the growth rate witnessed in China, the Indian lift market has been steadily growing.

Despite various roadblocks like the 1997 Asian Financial Crisis, 2008 Lehman Brothers collapse and recent pandemic, the market has always bounced back immediately on to the growth path.



While a 2.5 m/s lift was considered high speed and as such a rarity in the last century, 4.0 m/s and 6.0 m/s lifts are now common.

As per the Madras Consultancy Group (MCG), the market is expected to cross the hundred thousand market by 2024.

NOTE: Over the last decade numerous unorganised micro installation and maintenance companies have mushroomed around the country. It is almost impossible to estimate the annual sales of this segment. Therefore, it is this author's opinion that the MCG estimate is understated.

With the market potential it is not surprising that the global OEM majors Otis, Kone, Mitsubishi, Schindler, TK Elevator (erstwhile Thyssenkrupp), Fujitec, Hitachi and Toshiba, in order of their entry, have set up their Indian companies. Hyundai too has its operation through an Indian partner.

Some of the domestically grown companies too have grown their businesses. Johnson Lifts (established in 1963) is one of the market leaders selling more lifts annually than the multinational OEMs. Eros (established in 1947) is the oldest registered lift company in India that is still in operation.

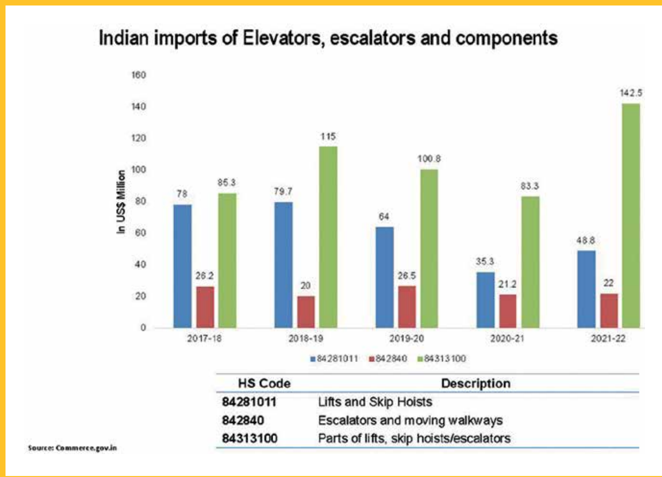
SOURCING

India has substantially large manufacturing capabilities. Barring rare earth minerals and guide rails, India manages over 80% of its supply requirements domestically. Amongst the OEMs, Kone and Johnson Lifts have the largest manufacturing setups while Otis has the oldest setup. Fujitec, Mitsubishi, Schindler and TK Elevator have also invested heavily in domestic manufacturing.

Global component suppliers like Arkel, Fermator, Montanari and Wittur have large manufacturing facilities in India.

Imports are either limited to high-end lifts and equipment or cheap substitutions. Chinese players, over the last 2 decades, have made aggressive inroads into the Indian market and played a significant role in driving down prices and in some areas driving down quality.

With the large domestic market and available manufacturing capability, India has the potential to be a market hub for lifts and escalators. The International Sourcing Exposition for Lifts and Escalators (ISEE 2022 – Dec 1st to 3rd, 2022) is a step towards exploring this potential.



THE MARKET DRIVERS

As per MCG, "Apart from the large metropolitan cities, Tier I and Tier II cities are witnessing a space crunch, especially within the core city areas. Companies are shifting focus towards the Tier III cities as well". The infrastructure development (airports, metros) across the country will also spur growth.

Further MCG research indicates that residential development has already crossed the pre-pandemic levels while commercial development is creeping back to the pre-pandemic levels.

The 1.3 billion population and crowded cities will continue to drive the vertical growth of the cities.

INDIAN STANDARDS

The genesis for the Indian standards for lifts is the Bombay Lift Act of 1939. With the establishment of the Indian Standards Institution (ISI) that came into being in 1947 and rechristened as the Bureau of Indian Standards (BIS) in 1986, the Lift and Escalator Standard came under the purview of Bureau of Indian Standards.

The ET25 committee set up by BIS consisting of a diverse group of domain experts oversees the standards development process. The ET25 committee in turn has set up the P4 committee of industry experts to carry out the actual drafting work of the standard as well as review comments and opinions.

The current standard, Indian Standard (IS) 14665 which is prescriptive in nature has evolved with time and been very progressive. India was one of the first countries to adopt a standard for MRLs as well as a standard for coated steel belts.

India's National Building Code (current version NBC 2016) is in line with the prevailing IS and provides detailed recommendations and guidelines from an architects' and developers' perspective.

Through the pandemic, the P4 panel worked on adopting various ISO standards including ISO 8100 Part 1 & 2. ISO 8100 Part 1 & 2 has been drafted as IS 17900 Part 1 & 2 and soon will replace IS 14665.

Lift and Escalator regulation in India is a state subject and therefore IS and NBC requirements tend to be recommendatory in nature. Only 13 of the 30 states have a regulation to date. The states that have a regulation normally tend to adopt the IS & NBC provisions.

QUALITY CONCERNS & REMEDIES

With the rapid growth, India is also witnessing an increase in incidents involving lifts and escalators.

The primary trigger for this is ineffective enforcement where regulation exists and the total absence of enforcement where there is no regulation. The ineffective or absent regulation allows the mushrooming of lift companies without the required knowledge, experience and infrastructure. The newly formed Elevator & Escalator Component Manufacturers' Association of India (EECMAI) has started lobbying various government bodies to bring lifts and escalators under the central government.

The second trigger is the lowering of entry barriers in terms of technical competency and experience. With the rapid growth of the industry and focus on short term profitability, the robust and effective training approach of yesteryears has been done away with. The training now is mainly quick capsules of classroom and training tower sessions. The issue is compounded multifold when these trainees in time become entrepreneurs running their lift and escalator companies. EECMAI is also trying to address this issue.

The third cause is user awareness. The Elevator & Escalator Safety Trust (EEST) has been trying to address this matter since 2008. However, with the limited support from the overall industry and others to support this initiative, the progress has been very slow.

OPPORTUNITY INDIA

With the growing domestic market and alignment with ISO standards, India is a great opportunity for multinational and domestic companies looking to grow and expand their business.

BIOGRAPHY

TAK Mathews, with over 3 decades experience in the construction and vertical transportation industry, TAK Mathews is the principal consultant at TAK Consulting.

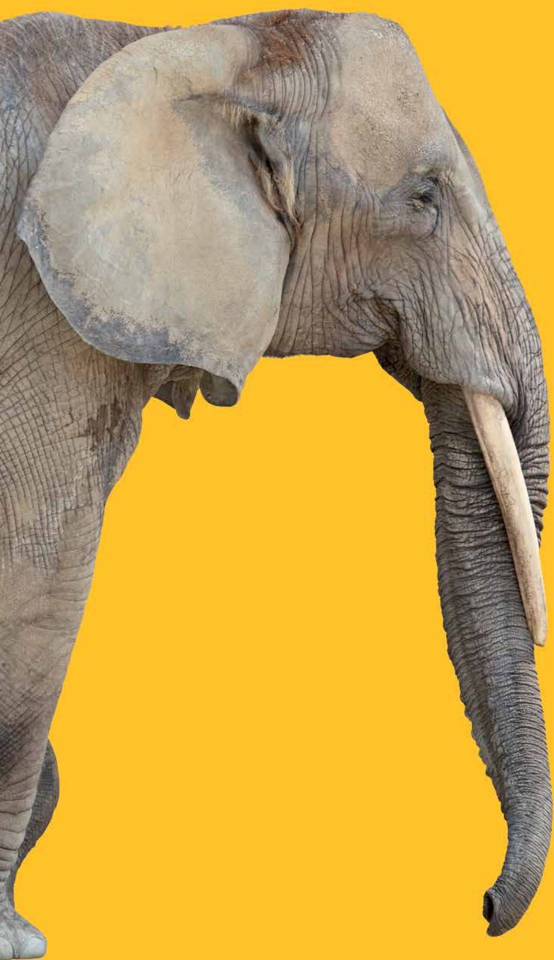
TAK is a representative on the committee constituted by the Bureau of Indian Standards for rewriting the Lift & Escalators Codes. He is the Convener of the Panel for writing codes for Lifts and Escalators for the National Building Code of India.

He is a member of various associations like the International Association of Lift Consultants (IAEC), Council for Tall Buildings and Urban Habitat (CTBUH) and Consulting Engineers' Association of India (CEAI).

AN ELEPHANT IN THE (MACHINE) ROOM

Replacement of Landlines with Mobile (GSM) Gateways for Lift Emergency Communication

JASON GODWIN
2N Regional Sales Manager



INTRODUCTION

In this paper the author seeks to bring the reader's attention to an emerging problem. This problem is the requirement for lifts' emergency phones under EN81:28 to place automatic test calls every 3 days with the assumption that such calls are monitored, acted upon if not received, and that a complete log of such calls can be provided to the lift owner, or a nominated party. A lift should not be in service if the emergency phone is not in service and, therefore, if an automatic test call is not received then the responsible party maintaining the lift must investigate and, it is suggested, shut down the lift in a controlled manner until the emergency phone is confirmed to be operational.

The author suggests that whilst telephone exchanges connecting landlines have been upgraded to properly support Dual Tone Multi-Frequency (DTMF) since November 1963, no such rigorous consideration was ever given to the design and operation of mobile networks to support critical test calls, which the lift industry had conveniently automated using DTMF to reduce the burden on human call centre and call monitoring resources.

It should be understood that for voice and Internet Protocol (IP) data calls the mobile networks operate very effectively but little consideration has been given to the transmission of DTMF signalling, which is used for identifying lifts in an emergency call and also registers the automated 3-day test calls to comply with code EN81:28.

The author suggests that there is a growing body of anecdotal evidence based on industry feedback that some proportion of these automated test calls using DTMF, perhaps as high as **ten-to-fifteen percent (10-15%)** are being lost, scrambled or otherwise failing to transit properly, resulting in a failure of responsible parties to log such calls and respond properly when such calls fail. At a practical level that leaves uncertainty for lift passengers as to whether the emergency phone works correctly and, therefore, as to whether a lift should even be in service.

This issue is, in the opinion of the author, firmly a result of the inherent unsuitability of the mobile networks currently to transmit critical DTMF calls and the lift industry's determination to keep operating in that manner. Furthermore, the author respectfully suggests that this is matter of sufficient concern that industry bodies such as CIBSE Lift Group and/or the BSI/MHE/4 committee should review the matter and investigate for themselves the scope and scale of the problem, as lift safety, of which the emergency phone forms a core component, should not be ignored by lift industry participants and the standards governing bodies.

2. LIFT CODE CONSIDERATION

The clause 4.2.1 of EN81:28 states two important requirements:

- The alarm system shall be able to operate at all times when the lift is intended to be accessed by users.
- The alarm equipment shall automatically simulate the input signal of an alarm (automatic test) and set up the subsequent connection, using the same connection means used for an alarm, to the reception equipment for testing purposes as frequently as agreed with the owner of the installation but at least every **3 days**.

There exists a BSI DD 265:2008 draft named "Protocol for Communications between a lift alarm system and an alarm receiving station (rescue centre)" that seeks to codify a standard around DTMF transmission as it relates to lift signalling. However, it was neither adopted nor focused on the network and technology differences between landlines and GSM/UMTS/VoLTE. It does, however, make a passing reference to changes happening with regard to PSTN and GSM to accommodate new internet developments such as Voice over Internet Protocol (VoIP) and suggests users are informed of these developments. Importantly, the aforementioned draft does, firstly, highlight the importance of having a permanent record of all communications in accordance with BS EN 81-28:2003 and, secondly, in case of periodic test calls, the importance of making a record. The author suggests that neither of those objectives is being currently met in a comprehensive manner when mobile GSM gateways are implemented.

3. DIGITAL SWITCH BACKGROUND

In the UK, telecoms network fibre lines are being rolled out across the country to replace copper lines, known as the digital switch. It is expected the vast majority of copper lines will be disconnected by late 2025 and no later than 2026. This affects both PSTN and ISDN lines. Lifts relying on landlines for emergency calls will lose the ability to call once those lines are disconnected. Even now operators are stopping the sale and ownership transfer of existing lines, we understand, hastening the demise of such copper landlines.

Fibre connections, by design, are not powered as copper landlines are, so they require power and, in case of power failure, some Uninterrupted Power Supply (UPS) to the Optical Network Terminal (ONT) from where an analogue line is created and provided to a lift. The extent to which that power backup can serve the wider connectivity of the fibre network (ring) is unclear and so this is far from a robust solution. The norm also requires monitoring of batteries (UPS) and expects alerts when not capable of 1 hour standby or 15 minutes of operation.

As an alternative the lift industry is widely adopting GSM gateways to replace landlines. These units work on 2G (GSM), 3G (UMTS) and 4G (VoLTE) depending on the mobile communication module in the gateway. It should be noted that 3G has been, or will be, switched off in the coming 12 months or so as Spectrum has been, or will be, reformed for 4G (5G?). Even 2G will be shut down no later than 2033, but likely much sooner (see below), leaving 4G and 5G as the only likely mobile connectivity options.

Country	Network Operator	2G Status/ Sunset Date	3G Status/ Sunset Date	Source
	EE	31. 12. 2025	31. 12. 2022	GSMA
United Kingdom	3	No service	31. 12. 2024	GSMA
	Vodafone	31. 12. 2025	31. 12. 2023	GSMA

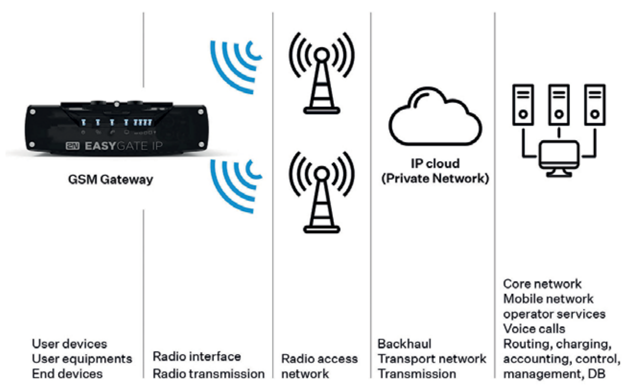
4. GSM GATEWAYS

To avoid the complexity and cost of utilising fibre lines in a code-compliant manner, the lift industry has turn to GSM gateways. Such gateways act on the basis of "pass-through" simply allowing outbound and, indeed, inbound calls from and to the lift emergency phone autodialler. In nearly all cases the lift emergency phone autodialler is of an analogue design and operation, requiring a powered connection, which all gateways provide via 2 or 4 wire connection to the lift cabin. Depending on age and advancement, the GSM gateway will operate on 2G, 3G or 4G/VoLTE service.

The problem of DTMF automated test-call signalling loss as described by the author is, in their opinion, common to all gateways and is not an issue inherent in a particular gateway or autodialler brand but is on the side of the mobile networks. This is explored and explained in more detail later.

5. PROBLEM DEFINITION

The reason for DTMF automated test-call loss is not obvious but it seems to be random in nature and not on the side of the gateway or autodialler manufacturer, as far as 2N can determine. DTMF was developed to send information about a required connection to the closest PBX. So its use for end-to-end signalling – not only for the test call but for any signalling from the lift communication device to a call centre (for example, the identification of the calling lift, error messaging etc.) – is somewhat of an extrapolation of its specified purpose and design intent. To understand the likely cause of DTMF disruption over mobile networks, one has to firstly recall that landlines moved to DTMF dialling decades ago and so were designed and improved for clear transmission of such signals. However, mobile networks have moved through a number of network standards – namely GSM, UMTS and now VoLTE, which is a form of VoIP – with DTMF being of little concern since common use cases, such as automated service selection (Press 1 or # for something), can be simply repeated if the signal (tone) is not received.



Whether those standards play a role in the DTMF disruption, or whether it is the myriad of radio network, edge network and core network elements through which calls pass that results in DTMF signals being lost, is unclear. One concern is the manner and the extent to which any Quality of Service (QoS) is applied to some, or all, of the network components and compression (codecs) applied. Another concern is the so-called media gateways, which are part of the telco operators' core network, and how they understand DTMF signals and the variation in decibels amplitude between the two tones. A wide difference might lead the lower tone to be processed as distortion, perhaps, and they will try to filter it out from the call. In GSM networks, as an example, though not necessarily directly related to or sole cause of DTMF disruption, "packet loss" is an accepted service degradation.

Packet loss of a GSM flow under variable load

	No QoS	QoS at gateway	QoS at edges	QoS in all nodes
Avg. packed loss %	9,0	5,6	0,1	0,1
Out of 9000 pkts	812	502	12	11

Test results of a GSM flow under heavy load

	No QoS	QoS at gateway	QoS at edges	QoS in all nodes
Delay (ms)				
average	28,5	15,9	19,4	21,2
mean deviation	10,6	4,5	4,7	4,7
Jitter (ms)				
average	20,7	20,0	20,0	20,0
mean deviation	7,7	6,5	6,4	6,5
Avg. packed loss %	10,5	0,48	0,54	0,52
Out of 9000 pkts	945	43	49	47

(Citation: Manner, Jukka. (2022). Provision of Quality of Service in IP-based Mobile Access Networks)

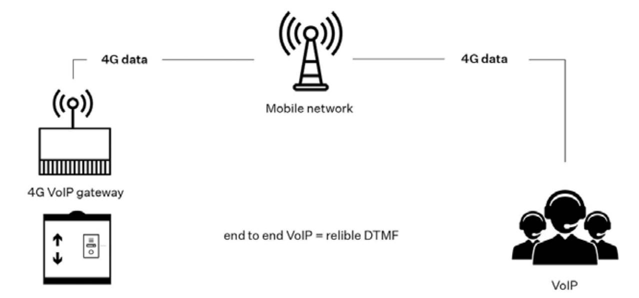
There is no doubt advanced mobile GSM gateways and autodiallers, like those produced by 2N, have a range of configuration relating to calls that can potentially assist in improving DTMF calling over mobile voice channels, such as setting tone length and tone spacing, but only in a limited respect. In our experience the parameter with the best effect is the selection of full/half-rate compression; using full-rate has the best outcome but that can be overruled by cell towers whose bandwidth may be limited for calls during busy periods or wide population coverage and demand. Other techniques that exist, and which can be explored, include disabling AMR (Adaptive Multi-Rate) modification of frequency characteristic etc, but such experimentation hardly forms the basis for a solid solution that can be communicated and much less implemented industry-wide.

6. SOLUTION

Firstly, there needs to be some industry admission of the issue and studies conducted to verify the problem does indeed exist and to quantify the likely scale of it. Then, an expert panel (CIBSE Lift Group and/or BSI/MHE/4 committee) should be convened to review the findings and seek input from the UK mobile operators as to their opinion and possibilities for technical solutions to resolve the issues. As a consequence of that investigation, it may be that consideration is given to recommending a solution for the lift industry, whereby both emergency calls and the DTMF signals relating to lift identity and test calls can be reliably routed with a better degree of end-to-end mediation, or perhaps tunnelling, not unlike how VPNs operate.

One solution already available on some mobile GSM 4G gateways is the use of VoIP with Session Initiation Protocol (SIP), which allows an IP-enabled PBX with SIP-enablement to register the GSM 4G gateway (with integrated SIP client) and effectively create a "tunnel" for the call, not unlike a VPN; this provides an end-to-end assurance of the call quality resulting in clear voice (audio) and, most importantly, excellent DTMF signalling of test calls and other data. An additional benefit of this approach is that communication is purely via a data call and thus no "voice-calling-plan" is required for the SIM in the gateway.

Here's a schematic showing how a lift emergency phone would use the gateway to connect to a call centre using VoIP (SIP):



Here's a schematic showing how a lift emergency phone would use the gateway to connect to a call centre using VoIP (SIP):

7. CALL FOR DISCUSSION & RESEARCH

The author respectfully requests that some form of ad-hoc technical committee be formed by the CIBSE Lift Group as a matter of some urgency and that it be tasked with the objective of documenting industry feedback and seeking technical input from the UK mobile operators likely via their industry bodies, including;

- GSMA (GSMA Intelligence - Source of Mobile Industry Insights)
- Mobile UK (***https://www.mobileuk.org/contact***)

Following on from that should be a report confirming or resolutely denying the existence of the aforementioned problem with the understanding that only some threshold of zero, or close to zero, is acceptable in regard to the loss of automated test calls.

8. CONCLUSION

Though it appears counter-intuitive for a successful manufacturer of lift GSM gateways to highlight this issue, which is based on lift industry feedback across all makes of gateways, the author believes the necessity to confront this issue outweighs commercial interests. In doing so this will shed light on those manufacturers who refuse to acknowledge the issue and promote the switch from landline to GSM gateway without considering any implications whatsoever, to the detriment of their customers and the lift industry.

It is hoped that this report provides the impetus for a study, as described, and creates a better understanding of the problem leading to a robust solution, which may be a move to VoIP using SIP, or perhaps a change in the way the mobile networks manage DTMF, or indeed some other solution. 2N as a global supplier of lift GSM gateways to major OEMs, along with a range of analogue and IP emergency phones and communication solutions, offers its support and encouragement in the exploration and resolution of the highlighted issue.

BIOGRAPHY

Jason Godwin is a Regional Sales Manager at 2N with responsibility for lift products across the UK, Australia and North American markets. He started work in the UK lift industry under his father, Mike Godwin before emigrating to Australia where he worked for Kone and Boral Elevators (OTIS) rising to senior management level on new lift sales and also modernisations. He then returned to Europe settling in Prague and, in the absence of lift industry opportunities there, decided to focus on telecommunications while also assisting his brother Adrian Godwin at Lerch Bates Europe from time to time. Jason holds an MBA from RMIT University in Melbourne, Australia.

THE EVER-POPULAR **LIFT & ESCALATOR SYMPOSIUM** RETURNS AS A FACE-TO-FACE EVENT!

Richard Peters looks back at the 13th LES in September 2022.

I don't think I have ever seen so many smiling faces at a lift conference! Post-pandemic, we all really appreciated the chance to meet again in person. Old friendships were renewed, and new ones formed. And not forgetting the purpose of the Symposium, we were literally bombarded with reports on new research and developments from across the globe. It is an exciting time to be part of our industry and there are many new innovations; events like the Lift & Escalator Symposium give us an excellent overview of what is new and "coming soon".

http://www.liftsymposium.org

This year we had 26 papers and a panel discussion over two days, making it a packed and fast-moving programme. The 15-minute time slot for each speaker encouraged everyone to focus on the key innovations, leaving the written paper to speak to the details. This format was popular with delegates; even the most committed conference delegate would prefer not to have a line-by-line exposition on the derivation of equations for traffic analysis, something I have been guilty of in the past!

In case of a recurrence of the pandemic, the event was planned to be hybrid, allowing people to join online or in person. Thankfully there are no longer restrictions in the UK and the COVID risk had dropped to a point that few were concerned about travelling to the venue in Northampton. In any case, we did have some online visitors, including three speakers who were unable to travel. The technicalities of running a zoom call in a conference room are complex, but the technology worked, including conversations between online speakers and delegates in the room.

The conference was opened by Stefan Kaczmarczyk who also chaired the first session on *Engineering and Energy*. Matthew Appleby talked about the Generation and application of dynamic kinematics (without using any equations!) and Gabriela Roivainen addressed *Dynamic simulations for lift health diagnosis*. Jaakko Kalliomaki took us back in time in his paper *1927 - the year that set the direction of traction lift engineering for a century*. Adam Scott and Richard Peters both addressed energy, Adam with his paper E*nergy efficient buildings – Assessing the impact of lifts and escalators* and Richard with his paper *Lift energy modelling for green building design*.

The need for our industry to consider the environmental impact of our design choices was one of the recurring themes at the conference.

Session 2 was titled *IoT and Technology*, chaired by Philip Hoffer. Kenneth Ong, Paul Clements and Michele Guidotti all spoke on the Internet of Things (IoT), which was another recurring theme of the conference.

Read Paul's paper in issue 2 of lift Industry News

Kenneth's paper was titled *Setting standards on remote monitoring & diagnostic for lifts – a Singapore context*, Paul's was *Exploring IoT applications for vertical transportation (VT) to tackle challenges in a modern world*, and Michele's was *Lift IoT: Turning sensor data into value*. Miguel Castro reminded us about the importance of Building Information Modelling (BIM) with his paper *Lift Industry and BIM: a long overdue adopted and typically overlooked project enabler*.

Session 3, *Traffic Analysis and Dispatching* was chaired by Graham Barker. For those of us heavily engaged in this topic, the Symposium is where we pore over every paper and then discuss them enthusiastically in groups during the breaks; there was plenty to discuss in 2022! Lutfi Al-Sharif presented on *Enhancing the I-S-P method (Inverse Stops-Passengers) using the Monte Carlo Simulation method*, and Jonathan Beebe on *Global dispatcher interface - initial prototype design*. Aitor Arrieta discussed *Design-Operation continuum methods for traffic master*, Diana Andrei addressed *Impact of the load-area bypass feature on passenger service level* and finally, Gina Barney spoke to the *Rated load and maximum available car area - A proposal to revise EN81-20, table 6*.

Session 4, the final of Day 1, was titled *Maintenance* and chaired by Nick Mellor. The session picked up the IoT theme and related technologies in the context of maintenance and repair. Stefan Kaczmarczyk presented *Vibration signature and the application of intelligent pattern recognition in detection and classification of damage in automatic power operated lift doors*, Matti Lin spoke on *System simulation for fault analysis of lift doors* and Rory Smith on *The effect of artificial intelligence on service operations and service personnel*.

The conference dinner followed, with a fine three-course meal and wine. The conversation continued into the evening in the bar!

Day 2 began with session 5, *Planning & Design*, chaired by Richard Peters. It began with an invited speaker, Marja-Liisa Siikonen, presenting an overview her new book *People Flow in Buildings*. This major piece of work shares much of Marja-Liisa's extensive experience. We learnt from the Q&A that her book is now available on Amazon. Continuing the session, we had papers from Janne Sorsa on *New evidence on lift passenger demand in high-rise office buildings*, Kasinadh Karra on the *Component based modular elevator* and Phil Pearson on *The technical challenges involved in lifting 40 Tonne trucks using rigid chain technology in a confined space*.

A highlight for many was session 6, a panel discussion, chaired by Adam Scott titled "Post-COVID: the impact on building and vertical transportation design". Neil Pennell gave us the thinking behind the British Council of Office (BCO) 's recent position paper as they seek to reflect on the changing use of offices following the pandemic. More insights were provided by the other panellists Len Halsey, Rory Smith, and Jochem Wit as they considered the implications of the pandemic on current requirements and the uncertainty of what will happen in the future.

The final session was chaired by David Cooper and titled *Safety*. Daniel Meekin spoke on *Investigation into the closing force of passenger/goods lift automatic power operated doors and recommendations to reduce the risk of injury to lift users* and Mateusz Gizicki on *The investigation of efficacy and fire propagation thwarting characteristics of fire barrier in the lift industry applications*. Returning to the IoT theme, Andrew Gorin spoke on *IoT safety predictive monitoring of lift operations, shafts and buildings*.

Finally, there were papers from Qingping Guo on *Disinfection efficacy analysis of an Ultraviolet-C (UVC) device for escalator handrails* and Nick Mellor on *Challenges to drafting a standard for the evacuation of disabled people using lifts*.

The conference was closed by co-chairs, Stefan Kaczmarczyk & Richard Peters who thanked the Lift & Escalator Symposium Trust trustees, scientific committee, speakers and delegates for all their efforts which make this event so successful. The full proceedings are available to download from **http://www.liftsymposium.org**. The papers and videos will also be added to **www.liftescalatorlibrary.org**, the charity's fast-growing library of lift (elevator) and escalator technology research papers and documents.

The 14th Lift & Escalator Technologies Symposium will take place on 20 - 21 September 2023. Speakers are invited to submit abstracts at **http://www.liftsymposium.org**

BIOGRAPHY

Richard Peters has a degree in Electrical Engineering and a Doctorate for research in Vertical Transportation. He is a director of Peters Research Ltd and a Visiting Professor at the University of Northampton. He has been awarded Fellowship of the Institution of Engineering and Technology and of the Chartered Institution of Building Services Engineers. Dr Peters is the author of Elevate, elevator traffic analysis and simulation software. He is a Trustee of the Lift & Escalator Symposium Trust.

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MODELLING ELEVATOR TRAFFIC WITH SOCIAL DISTANCING IN A UNIVERSITY CLASSROOM BUILDING

DAVID SWINARSKI
David Swinarski was the 2022 winner of the Napier Shaw Bronze Medal, awarded each year by CIBSE in recognition of the highest rated research in the building services industry published by their journal, Building Services Engineering Research and Technology (BSER&T). David developed a simulation tool to assess the impact of various interventions on traffic carrying capacity of lift groups during the COVID-19 pandemic, when occupancy of lifts was curtailed as a means to reduce transmission risks.

Abstract: Social distancing standards implemented during the COVID-19 pandemic may have negative effects on vertical traffic. We describe a model and use it to predict the elevator traffic under social distancing in a university classroom building, and study the effects of four interventions aimed at improving this traffic. Discrete event-based simulation is used to study whether the lift group meets the forecasted demand when the car capacity is restricted far below its ordinary value to accommodate social distancing. Four low-cost interventions are simulated alone and in combination to quantify the improvements they offer. All four interventions show some improvement, and the combination of all four interventions gives the greatest improvement.

Practical Application: Implementing social distancing standards may disproportionately lower the car capacity relative to the building population and thus negatively affect vertical traffic. Building managers seeking to implement low-cost measures to improve elevator traffic under these conditions may look to the percentage improvements described here to aid them in selecting interventions appropriate to their buildings.

1. INTRODUCTION

In response to the global COVID-19 pandemic, many organizations, including universities, seek to implement social distancing standards in their buildings, which will affect vertical traffic. In this paper, we describe a model and use it to predict the elevator traffic under social distancing standards in a twelve-floor university classroom building during the period between two course blocks. We then study the effects of four different interventions.

The data for this study were provided by a university in a large US city under the condition that it not be identified in any subsequent publications. Most of its courses are scheduled in blocks. Here, we analyze the period between the first two blocks of the day: 8:30–9:45 am and 10:00–11:15 am. 8:30 am is a relatively unpopular time, and a small number of courses are offered in this block. 10 am is a relatively popular time, and a large number of courses are offered in this block.

The data describe enrollments in a 12-floor building, which we shall refer to as Building 1. Traffic enters the building through its lowest floor, which is connected to the upper floors by three stairways and six elevators. Floors 2-12 contain classrooms as well as offices for faculty and staff, event spaces, and lounges. Each of the floors 2-12 have a rectangular floorplan bisected by a long central corridor. One staircase is located at each end of this corridor, and the six elevators and third staircase are located midway along the corridor. The lift traffic control algorithm is the directional collective control with a nearest car policy, and the rated speed is 350 feet/min (1.78 m/s).

Social distancing standards in response to the COVID-19 pandemic reduce the number of people allowed at one time in classrooms, hallways, stairs, and elevators from their ordinary capacities. The university's analysis found that maintaining a six-foot social distancing standard reduces most classrooms to one third of their ordinary capacity. Under ordinary circumstances, Building 1's cars have a rated load of 4500 pounds (2041 kg) and a probable car capacity of 25 people. We model the effect on vertical traffic if the car capacity is lowered to 2, 4, 6, 8, or 12 people at a time. Several interventions for improving the vertical traffic have been proposed.

To avoid delays due to disruptions in global supply chains and to minimize costs, the university prioritized the study of interventions that do not require new elevator hardware or software. Four such interventions were proposed.

1. Assign classes to classrooms on lower floors to the greatest extent possible;
2. Direct passengers in queues to sort themselves into pairs of passengers with a shared destination floor;
3. Set one or more cars to follow only car calls, so that these cars can go express from the first floor to upper floors and back;
4. Stagger half the course start times by 5 min.

The paper is organized as follows. First, we forecast the demand for vertical traffic, predicting the number of people seeking to move between each pair of floors by stair and by elevator, and model their arrival at the stairs and elevators. Next, we analyze the building's elevator traffic (without interventions) in two ways: by discrete event simulation, and using standard analytic formulae for uppeak traffic. We then study the effects of four proposed interventions and end with concluding remarks.

We believe this work is novel for several reasons:

- Vertical classroom buildings provide an interesting case study for elevator traffic analysis. On the one hand, the traffic between course blocks is mixed, involving significant uppeak, downpeak, and interfloor traffic all at once. On the other hand, because students' and instructors' class schedules are known, their origins and destinations can be inferred; this information is not typically available at this scale in more general buildings.
- Many elevator traffic design analyses take place before an elevator system is installed and assume that cars can be fully loaded to their rated load. Improving the traffic of an existing elevator system under social distancing standards constitutes a different design problem.
- Many institutions will seek to reprogram their elevator call dispatchers for greater efficiency under social distancing. The interventions considered here are of a different type.
- With social distancing, queue length is not just a satisfaction metric, but a safety metric, as queues must not exceed the social distancing capacities of lobbies.

2. FORECASTING DEMAND ON STAIRS AND ELEVATORS

A model for predicting routes

Significant research has taken place to infer origin-destination matrices from elevator traffic data.[1] In contrast, for a university classroom building, data describing a large portion of the traffic are directly available: once the students' and instructors' class schedules and the locations of these classes are known, the origin–destination matrix can be constructed from these data. This of course does not capture passengers who do not follow the most direct route from their origin to their final destination. (For example, a student whose origin is the fifth floor and final destination is the eleventh floor might first travel to the first floor to get a coffee before proceeding to the eleventh floor.)

At this university, many undergraduates enroll in fall classes throughout the summer, and classes are assigned to classrooms at the end of the summer. Thus, at the time of this writing, these data for Fall 2020 were not yet available. Therefore, we develop a model to predict passengers' routes.

The inputs to our model are:

1. p, the fraction of 8:30 am students who also have a 10 am class (based on historical data).
2. q, the fraction of 10 am students who also have an 8:30 am class (based on historical data).
3. $(a_1, \ldots, a_{12})$, the 8:30 am enrollments by floor. Write $a = \sum a_i$.
4. $(b_1, \ldots, b_{12})$, the 10 am enrollments by floor. Write $b = \sum b_i$.

We treat p as the probability that an 8:30 am student will remain for a 10 am class; q as the probability that a 10 am student also had an 8:30 am class; and b_j/b as the probability that a student with a 10 am class is destined for floor j at 10 am. We can now produce the origin–destination matrix M. The entry M_{ij} in row i column j indicates the number of students moving from an 8:30 am course on floor i to a 10 am course on floor j.

The incoming traffic destined for floor j is the expected number of students on floor j who do not have an 8:30 am course. Thus $M_{1j} = (1 - q)b_j$. The outgoing traffic on floor i is the expected number of students on floor i who do not have a 10 am course. Thus, $M_{i1} = (1 - p)a_i$.

The interfloor traffic from floor i to floor j (where $i \neq 1$ and $j \neq 1$) is given by the expected number of 8:30 am students on that floor who also have a 10am class, multiplied by the probability that their 10 am destination is floor j. Thus, $M_{ij} = pa_ib_j/b$. This algorithm is an easily implementable strategy for predicting desired routes from concise and accessible data. We validated this algorithm using additional data from Fall 2019 provided by the university. The origin-destination matrix for Fall 2019 routes predicted by this model agrees well with the origin-destination matrix built using actual Fall 2019 class lists and classroom assignments.

3. PREDICTING FALL 2020 ROUTES

We assume that every room that was used for a 8:30 am or 10 am course in Fall 2019 will be used again at these times in Fall 2020. However, we also assume that due to social distancing standards, the enrollment in Fall 2020 will be capped at one-third of the classroom's ordinary capacity. In almost every case, the Fall 2019 enrollments exceed one-third of the room's ordinary capacity, so we assume that these classrooms will be as full as they can be under this social distancing standard. We also include the instructors in this count, so that the resulting origin–destination matrix represents all passengers' routes (students and instructors).

Table 1 lists the predicted Fall 2020 enrollments by floor for 8:30 am and 10 am courses under the assumptions described above. We also show the number of classrooms used on each floor in one or both of these blocks. We also need the fractions p and q of 8:30 am and 10 am students who have two classes in a row. From Fall 2019, these fractions are p=0.45 and q=0.25. Using the algorithm previously described, we predict students and instructors' routes for Fall 2020 in Table 2.

4. FORECASTING ARRIVALS AT STAIRS AND ELEVATORS

Now that we have predicted passengers' routes, we next assess how they might select stairs or elevators, and how they will arrive at the stairs or elevators.

Table 1. Predicted Fall 2020 enrollments by floor.

	Enrollments		
Floor	8:30 am	10 am	Classrooms
1	0	0	0
2	0	0	0
3	27	39	3
4	23	25	6
5	112	162	14
6	10	32	4
7	0	30	2
8	0	0	0
9	22	30	5
10	27	68	7
11	0	44	4
12	0	0	0
Total	221	430	45

Table 2. Fall 2020 predicted passenger routes.

	1	2	3	4	5	6	7	8	9	10	11	12
1	0	0	29	19	122	24	23	0	23	51	33	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	15	0	1	1	5	1	1	0	1	2	1	0
4	13	0	1	1	4	1	1	0	1	2	1	0
5	62	0	5	3	19	4	4	0	4	8	5	0
6	6	0	0	0	2	0	0	0	0	1	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	12	0	1	1	4	1	1	0	1	2	1	0
10	15	0	1	1	5	1	1	0	1	2	1	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0

Table 3. General predictions of stair usage.

Floors travelled	Usage up (%)	Usage down (%)
1	80	90
2	50	80
3	20	50
4	10	20
5	5	5
6	0	0

We begin with some guidelines suggested by the literature. Table 3 on stair usage is a reproduction of Barney and Al-Sharif's Table 2.9.[2] Interviews with five building staff members indicate that this table does not accurately reflect the behavior of Building 1's population. They observe that that far more than 10% of passengers routinely take the stairs from the first floor to the fifth floor. A plausible explanation for this discrepancy is that university students are fitter than the population of a general building and therefore more willing to take the stairs.

We articulate a set of assumptions about Building 1's traffic based on observations by building staff members.

Assumption 1: Students and instructors decide in advance whether they take the stairs or elevators.

In terms of modelling and simulations, this means we can separate the population at the beginning into two groups (passengers taking stairs and passengers taking elevators) and model these two groups independently of each another.

Assumption 2: 20% of students and instructors will take the elevators no matter the length of their route. This accounts for people with limited mobility and people who are carrying items.

Assumption 3: People will be willing to take the stairs downward many floors.

Assumption 4: A larger-than-usual percentage of people will be willing to take the stairs up to four floors at a time.

Table 4 incorporates these assumptions. We use Table 4 in our simulations to forecast stair usage.

Table 4. Predictions of stair usage in Building 1.

Floors travelled	Usage up (%)	Usage down (%)
1	80	80
2	80	80
3	70	70
4	50	70
5	20	70
6-8	0	50
9-11	0	0

We can now partition the routes predicted in the previous subsection by stairs or elevators. The predicted elevator routes are shown in Table 5.

Table 5. Fall 2020 predicted elevator routes.

	1	2	3	4	5	6	7	8	9	10	11	12
1	0	0	6	6	61	19	23	0	23	51	33	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	3	0	0	0	1	0	0	0	1	2	1	0
4	4	0	0	0	1	0	0	0	1	2	1	0
5	18	0	1	1	0	1	1	0	2	6	5	0
6	2	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	6	0	0	0	1	0	0	0	0	0	0	0
10	15	0	1	0	1	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0

5. FORECASTING TRAFFIC ON ELEVATORS

Methodology

In the vertical transportation literature, two main approaches to computing performance statistics for multi-car lift systems are calculation and simulation. See Chapters 3 and 4 of the CIBSE guide,[5] Chapter 18 of the handbook,[2] and the excellent recent survey by Al- Sharif and Al-Adem.[6] Within each of these broad categories there are several techniques.

Historically, the first approach to calculation used basic probability theory to derive analytic formulae for several performance statistics including the round-trip time, uppeak capacity, and interval,[2] and these formulae are used in the sequel. However, the published textbook formulae do not capture all of the interventions we seek to study. The textbook formulae have been extended many times to handle increasingly general cases, but each such analytic derivation can be lengthy. Al-Sharif and his collaborators have introduced numerical approaches including Monte Carlo simulation to calculating these statistics.[7]

Queueing theory also has long history in these calculations, beginning with the foundational work of Alexandris and Barney and Harris[3,8] to determine formulae for additional performance statistics including the average queue length and average waiting time.However, in general, queueing theory approaches assume that the system reaches a steady state (though we note recent work by Al-Sharif et al.[9] introducing finite workspaces modelled using SimEvents in MATLAB under transient conditions). In the classroom building we are modelling, the elevator traffic shows heavy bursts during the 15 min periods between course blocks, and it is therefore not clear *a priori* whether a steady state will be achieved under the conditions we study.

Simulation is a well-established tool for studying elevator traffic, particularly for traffic that is not uppeak traffic.[2,5,10–13] Such simulations may either be discrete event based or timesliced. We chose simulation as our main approach to study the effects of the proposed interventions to avoid lengthy new theoretical derivations that would be required to analyze some interventions or combinations of interventions, and to avoid any concerns regarding steady states. When there are no interventions, we also include calculations using analytic formulae to corroborate the simulation results.

6. LIFT PERFORMANCE TIMES

Table 6 shows lift performance times in Building 1 estimated from data provided by the university. By definition, the lift performance time is the time elapsed as the doors close, the car rises, and the doors open to 800mm on the destination floor.[2,5] Notes from the university accompanying the data indicate that these data represent the time until the doors fully open. Thus, these figures overestimate the lift performance time. The door opening and closing times are $t_c = t_o = 3$ s.

Table 6. Building 1 lift performance time estimates.

Destination floor	Time (s)
2	11
3	12
4	13.5
5	15
6	17
7	18.5
8	20.5
9	22.5
10	26
11	28
12	30

7. FORECASTING ELEVATOR TRAFFIC BY SIMULATION

As discussed in the “Methodology” section, we use simulation as our main tool to study the effect of the proposed interventions. We wrote bespoke Python programs to simulate Building 1’s elevator traffic. The inputs are the lift performance times shown in Table 6 and the origin–destination matrix shown in Table 5. The program populates upward and downward queues on each floor using these numbers, randomly ordering the passengers in each queue. Next, arrival times are assigned to passengers in each queue according to a Poisson process designed to generate the expected number of arrivals in 5min on upper floors and in 15 min on the first floor.

The program creates and processes a dynamic list of “critical times” when an update to a queue’s status or a car’s status may be required.

Critical times include:

- Any time a passenger arrives in a queue (since this may or may not result in a new call);
- Any time a car arrives at a floor and completes unloading any passengers destined for that floor (since this may allow new passengers to load and/or the car to accept a new call);
- Any time a car completes loading passengers on a floor (since it can now be assigned its next call);
- One second after any car departs a floor, if the queue is still not empty, the remaining passengers will repeat the call that was just completed;
- 10 s after any car arrives and completes unloading, if it has not been assigned any additional calls, it returns to the lobby.

The program begins with the first passenger's arrival as its first critical time. With each loop, the program processes car arrivals; processes queue arrivals; loads any passengers into cars on the same floor in the correct direction until the car reaches capacity; then assigns landing and car calls to any cars that are ready for instructions. Calls were assigned by directional collective control with a nearest car policy as described in sections 9.2.2.3 and 9.4.1.1 of the CIBSE guide.[5]

Each loop may generate new critical times, since for example one or more passengers may load, or a car may depart a landing. The critical times are processed in order until all critical times have been processed. This completes one trial. The program outputs a text-based log narrating the trial, computes performance statistics of the trial, saves data produced in the trial, and produces a log that can be used to animate the trial.

In the six main tables presented in this section (Tables 7, 10 to 14), we report statistics obtained from these simulations. Each of these tables has six rows in which the maximum number of passengers per car P_{max} varies from 2 to 12. For each table, we produce 1000 sets of passenger arrival times in queues and use them in all six rows so that only input varying between rows is the number of passengers per car. For each row, we compute 1000 trials and report statistics.

Each trial took between 0.15 s and 0.20 s. We note that other published simulation studies have used 1000 trials.[12,14] Furthermore, for Table 7, we also ran 10,000 trials and obtained nearly identical results, suggesting that 1000 trials is indeed a suitable number for this study.

Here are descriptions of the six statistics reported in each of the main tables.

- For each trial, we compute the completion time, which is the time elapsed between the last passenger's arrival in a queue and the last car returning to the lobby, ending the trial. We report the average, standard deviation, and maximum of the 1000 completion times.
- For each trial, we compute the maximum length of any queue at any time, which always turns out to be the first floor queue. We report the average, standard deviation, and maximum of the 1000 maximum queue lengths.
- For each passenger in each trial, we compute the passenger's waiting time. We report the average, standard deviation, and maximum of these 300,000 times.
- For each passenger in each trial, we compute the passenger's transit time. We report the average, standard deviation, and maximum of these 300,000 times.
- We record the intervals (time between successive car arrivals at the main terminal floor with cars loaded to any level) from all 1000 trials. The number of intervals varies between trials. We pool the intervals from all 1000 trials and report the average, standard deviation, and maximum of this pool.
- For each trial, we record the number of refusals, that is, incidents in which an already full car stops at a floor to respond to a landing call and no passengers exit or board. We report the average, standard deviation, and maximum of these 1000 counts.

The results of simulation with no interventions are shown in Table 7. These simulations generally show acceptable results when there are six or more passengers allowed per car, although the maximum waiting time is slightly concerning.

Table 7. Simulation statistics with no interventions.

Pmax	Mean	6	Max	Mean	6	Max
	Completion time			Max queue length		
2	525.0	59.3	725.2	88.8	10.7	124.0
4	112.0	32.5	279.7	28.4	8.5	67.0
6	92.7	17.0	147.3	17.9	4.4	37.0
8	93.5	16.8	147.1	16.4	3.8	29.0
10	94.2	18.0	159.5	15.8	3.6	28.0
12	94.0	18.2	159.2	15.6	3.5	29.0
	Waiting time			Transit time		
2	239.5	150.8	659.0	26.2	10.2	76.1
4	47.5	37.2	385.3	33.2	14.0	96.7
6	19.5	18.3	341.6	36.1	16.8	106.2
8	15.6	14.3	227.7	37.5	18.7	115.8
10	14.4	13.1	207.7	38.3	19.9	120.6
12	13.9	12.6	148.9	38.9	20.8	127.8
	Interval			Refusals		
2	12.0	10.1	79.6	36.5	11.1	82.0
4	15.0	13.3	92.1	11.2	5.1	31.0
6	14.5	13.3	110.7	4.0	2.9	16.0
8	14.2	12.7	110.7	1.5	1.5	9.0
10	14.0	12.3	99.3	0.5	0.8	4.0
12	13.9	12.1	103.5	0.2	0.5	4.0

8. FORECASTING ELEVATOR TRAFFIC BY FORMULAE

As a check of the simulation results, we use standard formulas described for assessing uppeak elevator handling capacity.[2] Here, uppeak refers to passengers entering on the first floor en route to the upper floors.

We begin by computing the uppeak round trip time (RTT). First, we describe the variables that appear in the formula for RTT in the handbook.[2]

t_p the loading/unloading time for a single passenger
t_c the door closing time
t_o the door opening time
t_f (1)time to advance one floor from a stop
t_v the time to travel one floor at rated speed
t_s the time added by each stop:
$t_s = t_f(1) + t_c + t_o \quad t_v$
S the average number of stops per round trip
H the average highest floor reached
P the average number of passengers carried

The formula for RTT shown below is taken from Eqn. 4.8 of the handbook.[2]

$$RTT = 2Ht_v + (S + 1)t_s + 2Pt_p \qquad (1)$$

Let P_{max} denote the maximum number of passengers allowed per car. Social distancing standards may lower P_{max} below the ordinary rated car capacity and probable car capacity. We seek to compute RTT as P_{max} ranges from 2 to 12. We use the one-way travel time from the first floor to the second floor for the sum $t_c + tf(1) + t_o$, and estimate t_v as 2 seconds per floor. This yields $t_s = t_c + t_f(1) + t_o - t_v = 11 - 2 = 9$. Barney and Al-Sharif indicate that a standard value for t_p is 1.2 s.[2]

We explain below how we compute *P*. Once in hand, the expected values of *H* and *S* as functions of *P* may be computed using Barney and Al-Sharif's formulas (7.14) and (7.7).[2] The *uppeak interval* UPPINT is the average time between successive car arrivals at the main terminal floor with cars loaded to any level. With six cars, UPPINT = $\frac{RTT}{6}$.

The average number of passengers carried *P* may be smaller than the maximum number of passengers allowed per car P_{max}. To account for this possibility, we adopt the iterative procedure suggested by Alexandris, Harris, and Barney.[15] We begin with $P = P_{max}$, then compute RTT and UPPINT and set *P* to the number of passengers expected to arrive in one interval if this is smaller than P_{max}. We repeat this procedure until the value of *P* converges.

Finally, once we obtain the value *P* associated to P_{max} and the corresponding value for RTT, we compute two additional statistics. The average uppeak handling capacity UPPHC of 6 cars carrying *P* passengers each making 60/RTT trips per minute for 5 min is given by the following formula.

$$\text{UPPHC} = \frac{60}{\text{RTT}} \cdot P \cdot 6 \cdot 5.$$

The *passenger average travel time* ATT is the period of time that a passenger spends travelling in a lift measured from the time the passenger boards the car until the instant that the passenger alights at the destination floor (Def. 6.8 in literature[2]). (In the tables presenting data from simulation, we call this travel time.) Several formulae are used for ATT; we use a formula due to So and Suen.[2]

$$\text{ATT} + 0{:}5 \frac{S+1}{S} Ht_v + 0.5(S+1)t_s + 1.5Pt_p.$$

We use the first row of Table 5 as the forecasted demand for uppeak traffic during the period between course blocks. In total there are 222 passengers seeking to take the elevators from the first floor to upper floors during this 15 min period, or 74 passengers per 5 min. This yields Table 8. Upon iteration, values of P_{max} greater than 4 also yielded P≈3.35 because the forecasted demand is met with this value of *P*. Hence we display the outputs for P_{max} = 4 - 12 in one row in this table.

Table 8. Five-minute uppeak traffic statistics.

P_{max}	*P*	*H*	*S*	
2	2	9.07	1.8	
4–12	3.36	9.9	2.7	
	RTT	UPPHC	UPPINT	ATT
2	66.4	54	11.1	30.3
4–12	81.1	74	13.5	36.3

RTT: round trip time; UPPHC: average uppeak handling capacity; UPPINT: uppeak interval; ATT: average travel time.

We see that with just two passengers per car, the UPPHC is only 54 passengers per 5 min, which falls short of the forecasted demand of 74 passengers per 5 min. With four or more passengers per car, the UPPHC computed with these formulae meets the forecasted demand. Interval can be computed both by simulation and by the analytic formulae above, and the values obtained agree well. The average transit time computed by simulation can also be compared to the average travel time computed by analytic formulae. By definition, transit time ends when the doors begin to open at the destination floor, whereas average travel time ends when the passenger alights at the destination floor (see section 6.14 of literature[2]). With P_{max} = 2, the average transit time by simulation is 26.2 s, and the average travel time is 30.3. With P_{max} = 4, the average transit time by simulation is 33.2 s, and the average travel time is 36.3. These differences of 4.1 and 3.1 s may be explained by the door opening at the destination floor (3s) and passenger unloading times (1.2 s per passenger). We conclude that these values agree reasonably well.

Table 9. Fall 2020 predicted elevator routes, Intervention 1.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	0	0	12	6	61	19	23	0	23	35	18	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	6	0	0	0	2	1	1	0	2	3	1	0
4	4	0	0	0	1	0	0	0	1	1	1	0
5	18	0	2	1	0	1	1	0	2	4	3	0
6	2	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	6	0	1	0	1	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0

Table 10. Simulation statistics, Intervention 1.

P_{max}	Mean	Δ	δ	Max	Δ	Mean	Δ	δ	Max	Δ
	Completion time					Max queue length				
2	327.2	(-38%)	61.6	512.1	(-29%)	56.2	(-37%)	10.7	89.0	(-28%)
4	85.5	(-24%)	16.8	166.8	(40%)	18.2	(-36%)	5.7	42.0	(-37%)
6	85.4	(-8%)	17.1	131.8	(11%)	13.4	(-25%)	3.3	27.0	(-27%)
8	86.4	(-8%)	18.2	140.8	(4%)	12.7	(-22%)	2.9	30.0	(+3%)
10	87.3	(-7%)	19.2	149.4	(6%)	12.5	(-21%)	2.9	30.0	(+7%)
12	87.0	(-7%)	18.8	163.9	(+3%)	12.5	(-20%)	2.8	30.0	(+3%)
	Waiting time					Transit time				
2	152.5	(-36%)	95.8	459.5	(-30%)	23.9	(-9%)	9.3	68.6	(-10%)
4	25.0	(-47%)	23.5	311.3	(-19%)	30.1	(-9%)	13.7	93.8	(-3%)
6	14.2	(-27%)	13.2	201.4	(-41%)	32.2	(-11%)	16.2	108.6	(+2%)
8	12.5	(-20%)	11.4	171.5	(-25%)	33.2	(-12%)	17.7	113.4	(-2%)
10	12.0	(-17%)	10.9	133.7	(-36%)	33.7	(-12%)	18.5	118.2	(-2%)
12	11.8	(-15%)	10.7 85.1	(-43%)	34.0	34.0	(-13%)	19.1	132.6	(+4%)
	Interval					Refusals				
2	11.6	(-4%)	9.5	70.9	(-11%)	18.9	(-48%)	7.0	43.0	(-48%)
4	13.5	(-10%)	11.8	131.9	(+43.1%)	6.0	(-47%)	3.5	22.0	(-29%)
6	13.1	(-10%)	11.3	129.2	(+17%)	1.7	(-57%)	1.7	11.0	(-31%)
8	12.9	(-9%)	11.0	117.4	(+6%)	0.5	(-66%)	0.8	4.0	(-56%)
10	12.8	(-9%)	10.9	127.4	(+28%)	0.1	(-74%)	0.4	4.0	(0.0%)
12	12.8	(-8%)	10.9	141.1	(+36%)	0.1	(-78%)	0.2	1.0	(-75%)

Table 11. Simulation statistics, Intervention 2.

P_{max}	Mean	Δ	δ	Max	Δ	Mean	Δ	δ	Max	Δ
	Completion time					Max queue length				
2	442.9	(-16%)	90.0	694.9	(-4%)	79.5	(-11%)	13.5	121.0	(-2%)
4	92.9	(-17%)	18.9	209.9	(-25%)	24.7	(-13%)	7.3	55.0	(-18%)
6	91.7	(-1%)	15.7	141.4	(-4%)	17.4	(-3%)	4.0	33.0	(-11%)
8	92.9	(-0.6%)	16.7	146.2	(-0.6%)	16.2	(-0.9%)	3.7	29.0	(0.0%)
10	94.0	(-0.3%)	17.3	158.4	(-0.7%)	15.8	(-0.3%)	3.5	28.0	(0.0%)
12	94.2	(+0.3%)	18.3	159.2	(0.0%)	15.6	(+0.1%)	3.5	29.0	(0.0%)
	Waiting time					Transit time				
2	208.5	(-13%)	134.1	657.2	(-0.3%)	25.2	(-4%)	9.4	73.7	(-3%)
4	36.3	(-24%)	32.3	403.0	(+5%)	31.5	(-5%)	12.7	91.9	(-5%)
6	18.4	(-6%)	17.6	415.1	(+22%)	35.1	(-3%)	15.9	108.6	(+2%)
8	15.3	(-2%)	14.2	206.4	(-9%)	37.0	(-1%)	18.1	115.8	(0.0%)
10	14.3	(-0.7%)	13.1	150.9	(-27%)	38.1	(-0.5%)	19.6	120.6	(0.0%)
12	13.8	(-0.2%)	12.6	205.9	(+38%)	38.8	(-0.3%)	20.6	127.8	(0.0%)
	Interval					Refusals				
2	11.3	(-6%)	9.7	81.0	(+2%)	36.1	(-1%)	10.9	77.0	(-6%)
4	14.0	(-7%)	12.3	86.4	(-6%)	11.5	(+3%)	5.4	34.0	(+10%)
6	14.2	(-3%)	12.8	102.3	(-8%)	4.0	(-0.4%)	2.9	17.0	(+6%)
8	14.0	(-0.9%)	12.5	100.2	(-10%)	1.5	(-1%)	1.4	10.0	(+11%)
10	14.0	(-0.3%)	12.3	97.6	(-2%)	0.5	(+3%)	0.8	5.0	(+25%)
12	13.9	(+0.0%)	12.2	94.9	(-8%)	0.2	(+4%)	0.5	4.0	(0.0%)

9. THE EFFECTS OF FOUR PROPOSED INTERVENTIONS

Intervention 1: Assigning classes to lower floors.
The first intervention we study is to assign classes to classrooms on lower floors to the greatest extent possible. This reduces elevator usage in two ways. First, many passengers will be able to use the stairs instead of elevators, reducing the total number of people traveling by elevator. Second, those who do travel by elevator will take shorter trips.

We move two classes from the tenth floor to the third floor, and two classes from the eleventh floor to the third floor. The resulting matrix of routes is shown in Table 9. The results of simulation are shown in Table 10. In this table, the columns labeled Δ show the percent change from the control. Most of these statistics show at least 10% improvement compared to the control, and many of these statistics show much more improvement than this (20–50%).

10. INTERVENTION 2: PAIRING PASSENGERS WITH A SHARED DESTINATION FLOOR

The second intervention we study is to direct passengers in queues to sort themselves into pairs of passengers with a shared destination floor. This reduces the expected number of stops a car will make in each round trip. The results of simulation are shown in Table 11, where the columns labeled Δ show the percent change from the control.

When there are two or four passengers per car, several key statistics for this intervention show 10% to 25% improvements compared to the control. The improvements are more modest when there are six or more passengers per car, and a few statistics are worse compared to the control. For example, the maximum waiting time is 22% larger than the control when there are six passengers per car. We investigated this statistic further. In one trial, two passengers arrive in the fourth floor upward queue in the first minute of the trial, and experience ten refusals over the next seven minutes until finally boarding an elevator. Outside these two passengers, the next largest waiting time is 300 s, commensurate with the control group.

11. INTERVENTION 3: SET ONE OR MORE CARS TO FOLLOW ONLY CAR CALLS

The third intervention we study is to set one or more cars to follow only car calls, so that these cars can go express from the main terminal to the upper floors and back. We also assume that if there is no car call and the car is not on floor 1, it returns to floor 1. We let the number of such cars vary between 1 and 4. (For robustness, we did not want to have only one car in six responding to landing calls, in case this car was out of service.)

Most of the statistics are optimized when four of the six cars are set to behave this way. We present these results in Table 12. The columns labeled Δ show the percent change from the control.

While this intervention improves some statistics, such as the completion time, the maximum waiting time experienced by at least one passenger is far worse than the control—so much so that this intervention may be deemed unacceptable. Further study is needed to understand why this statistic grows so large. Perhaps, this could be addressed by modifying the intervention. For example, perhaps the queues on upper floors could be reorganized so that passengers traveling to the first floor would queue for the cars set to car calls, while interfloor traffic would queue for the remaining cars.

12. INTERVENTION 4: STAGGERING COURSE START TIMES

The fourth intervention we study is to stagger course start times in the following way. We shorten every class from 75 to 70 min. We assume half of the 8:30 am courses run 8:30– 9:40 am, and the other half run 8:35–9:45 am. Similarly, we assume that half of the 10 am courses run 10:00–11:10 am, and the other half run 10:05–11:15 am. This has the combined effect of stretching the period between course blocks from 15 min to 25 min.

To model arrivals, we assume that students leaving 8:30 am or 8:35 am classes following a Poisson process in the first 5 min after their class ends (so the arrival times in each queue are a combination of two Poisson processes). We model students entering the building for a 10 am or 10:05 am course with a 15 min Poisson process, so the arrival times in the main terminal queue are also a combination of two Poisson processes.

The results of simulation are shown in Table 13, where the columns labeled Δ show the percent change from the control. The first three statistics show great improvement compared to the control, typically 25–60%.

13. COMBINING ALL FOUR INTERVENTIONS

The interventions studied here are not mutually exclusive, and one could consider implementing any subset of them simultaneously. We simulate the effect of all implementing all four interventions simultaneously. The results are shown in Table 14, where the columns labeled Δ show the percent change from the control. These statistics show vast improvement compared to the control (25–100%). Notably, this was the only simulation in which a limit of two passengers per car provided acceptable results.

Table 12. Simulation statistics, Intervention 3.

P_{max}	Mean	Δ	δ	Max	Δ
	Completion time				
2	427.9	(-19%)	57.9	604.7	(-17%)
4	89.6	(-20%)	21.7	196.5	(-30%)
6	84.5	(-9%)	16.8	141.5	(-4%)
8	85.8	(-8%)	17.9	141.1	(-4%)
10	85.4	(-9%)	17.9	140.3	(-12%)
12	86.3	(-8%)	18.4	148.9	(-7%)
	Waiting time				
2	206.4	(-14%)	130.1	836.0	(+27%)
4	37.7	(-21%)	43.6	617.3	(+60%)
6	18.8	(-4%)	23.9	442.1	(+29%)
8	15.5	(-0.8%)	18.3	277.3	(+22%)
10	14.4	(+0.5%)	16.7	248.3	(+20%)
12	14.1	(+1%)	16.0	240.0	(+61%)
	Interval				
2	11.2	(-7%)	9.7	66.7	(-16%)
4	13.4	(-11%)	12.2	87.5	(-5%)
6	12.8	(-12%)	11.5	110.7	(0.0%)
8	12.5	(-12%)	11.0	123.2	(+11%)
10	12.4	(-12%)	10.8	104.1	(+5%)
12	12.4	(-11%)	10.8	118.5	(+15%)

Mean	Δ	δ	Max	Δ
Max queue length				
76.5	(-14%)	10.9	107.0	(-14%)
21.0	(-26%)	6.6	49.0	(-27%)
15.0	(-16%)	3.4	32.0	(-14%)
14.0	(-14%)	3.1	26.0	(-10%)
13.8	(-13%)	3.0	28.0	(0.0%)
13.7	(-12%)	2.9	25.0	(-14%)
Transit time				
26.8	(+2%)	10.6	76.1	(0.0%)
34.2	(+3%)	14.6	107.2	(+11%)
36.8	(+2%)	17.3	124.6	(+17%)
38.3	(+2%)	19.2	130.1	(+12%)
39.1	(+2%)	20.3	136.9	(+14%)
39.6	(+2%)	21.1	152.9	(+20%)
Refusals				
32.9	(-10%)	10.1	59.0	(-28%)
10.1	(-10%)	5.0	28.0	(-10%)
3.0	(-26%)	2.3	16.0	(0.0%)
1.0	(-32%)	1.3	8.0	(-11%)
0.4	(-26%)	0.8	5.0	(+25%)
0.2	(-30%)	0.4	3.0	(-25%)

Table 13. Simulation statistics, Intervention 4.

P_{max}	Mean	Δ	δ	Max	Δ
	Completion time				
2	198.5	(-62%)	73.8	418.7	(-42%)
4	70.0	(-38%)	14.8	123.2	(-56%)
6	70.4	(-24%)	15.3	120.4	(-18%)
8	70.3	(-25%)	15.4	128.5	(-13%)
10	70.6	(-25%)	15.7	126.4	(-21%)
12	70.3	(-25%)	15.6	126.4	(-21%)
	Waiting time				
2	95.8	(-60%)	80.6	396.7	(-40%)
4	15.1	(-68%)	12.6	194.2	(-50%)
6	11.0	(-43%)	9.2	103.8	(-70%)
8	10.3	(-34%)	8.8	76.9	(-67%)
10	10.1	(-30%)	8.7	79.3	(-62%)
12	10.0	(-28%)	8.7	79.3	(-47%)
	Interval				
2	11.8	(-2%)	9.4	119.0	(+50%)
4	12.9	(-14%)	10.8	119.0	(+29%)
6	12.7	(-13%)	10.6	119.0	(+7%)
8	12.7	(-11%)	10.5	119.0	(+7%)
10	12.6	(-10%)	10.4	119.0	(+20%)
12	12.6	(-9%)	10.4	119.0	(+15%)

Mean	Δ	δ	Max	Δ
Max queue length				
46.3	(-48%)	9.0	77.0	(-38%)
14.2	(-50%)	3.7	33.0	(-51%)
11.7	(-35%)	2.5	22.0	(-41%)
11.4	(-31%)	2.4	23.0	(-21%)
11.2	(-29%)	2.3	21.0	(-25%)
11.2	(-28%)	2.3	21.0	(-28%)
Transit time				
24.0	(-8%)	8.5	76.1	(0.0%)
28.2	(-15%)	12.4	82.4	(-15%)
29.8	(-18%)	14.7	96.2	(-9%)
30.5	(-19%)	16.0	106.2	(-8%)
30.9	(-19%)	16.6	113.4	(-6%)
31.0	(-20%)	16.9	115.8	(-9%)
Refusals				
7.8	(-79%)	5.1	32.0	(-61%)
0.9	(-92%)	1.2	10.0	(-68%)
0.2	(-96%)	0.4	3.0	(-81%)
0.0	(-98%)	0.2	2.0	(-78%)
0.0	(-98%)	0.1	1.0	(-75%)
0.0	(-98%)	0.1	1.0	(-75%)

Table 14. Simulation statistics, all four interventions.

P_{max}	Mean	Δ	δ	Max	Δ
	Completion time				
2	55.5	(-90%)	16.9	171.2	(-77%)
4	53.5	(-52%)	13.5	104.4	(-63%)
6	53.7	(-42%)	13.8	122.4	(-17%)
8	53.8	(-43%)	14.1	122.4	(-17%)
10	53.8	(-43%)	14.0	122.4	(-23%)
12	53.8	(-43%)	14.0	122.4	(-23%)
	Waiting time				
2	31.8	(-87%)	35.3	492.8	(-25%)
4	11.9	(-75%)	15.4	215.1	(-44%)
6	10.7	(-45%)	13.8	190.6	(-44%)
8	10.4	(-33%)	13.6	152.9	(-33%)
10	10.4	(-28%)	13.5	121.9	(-41%)
12	10.4	(-25%)	13.5	121.9	(-18%)
	Interval				
2	11.2	(-7%)	11.8	152.3	(þ91%)
4	11.9	(-21%)	12.4	134.5	(þ46%)
6	12.0	(-18%)	12.4	134.5	(þ22%)
8	12.0	(-16%)	12.4	134.5	(þ22%)
10	11.9	(-15%)	12.4	134.5	(þ35%)
12	11.9	(-14%)	12.4	134.5	(þ30%)

Mean	Δ	δ	Max	Δ
Max queue length				
17.0	(-81%)	5.7	40.0	(-68%)
9.7	(-66%)	2.2	23.0	(-66%)
9.2	(-49%)	2.0	20.0	(-46%)
9.2	(-44%)	1.9	19.0	(-35%)
9.2	(-42%)	1.9	19.0	(-32%)
9.1	(-41%)	1.9	19.0	(-35%)
Transit time				
22.2	(-15%)	8.1	68.6	(-10%)
25.2	(-24%)	11.3	85.6	(-12%)
26.5	(-27%)	13.3	96.7	(-9%)
27.1	(-28%)	14.3	106.2	(-8%)
27.3	(-29%)	14.7	111.0	(-8%)
27.3	(-30%)	14.9	115.8	(-9%)
Refusals				
9.2	(-75%)	4.8	29.0	(-65%)
0.9	(-92%)	1.1	7.0	(-77%)
0.1	(-97%)	0.4	3.0	(-81%)
0.0	(-99%)	0.1	1.0	(-89%)
0.0	(-99%)	0.1	1.0	(-75%)
0.0	(-100%)	0.0	0.0	(-100.0%)

Table 15. Comparison of interventions for P_{max} = 6.

P_{max}	Mean	Δ	δ	Max	Δ
	Completion time				
None	92.7		17.0	147.3	
1	85.4	(-8%)	17.1	131.8	(-11%)
2	91.7	(-1%)	15.7	141.4	(-4%)
3	84.5	(-9%)	16.8	141.5	(-4%)
4	70.4	(-24%)	15.3	120.4	(-18%)
1234	53.7	(-42%)	13.8	122.4	(-17%)
	Waiting time				
None	19.5		18.3	341.6	
1	14.2	(-27%)	13.2	201.4	(-41%)
2	18.4	(-6%)	17.6	415.1	(+22%)
3	18.8	(-4%)	23.9	442.1	(+30%)
4	11.0	(-43%)	9.2	103.8	(-70%)
1234	10.7	(-45%)	13.8	190.6	(-44%)
	Interval				
None	14.5		13.3	110.7	
1	13.1	(-10%)	11.3	129.2	(+17%)
2	14.2	(-3%)	12.8	102.3	(-8%)
3	12.8	(-12%)	11.5	110.7	(0.0%)
4	12.7	(-13%)	10.6	119.0	(+7%)
1234	12.0	(-18%)	12.4	134.5	(þ22%)

Mean	Δ	δ	Max	Δ
Max queue length				
17.9		4.4	37.0	
13.4	(-25%)	3.3	27.0	(-27%)
17.4	(-3%)	4.0	33.0	(-11%)
15.0	(-16%)	3.4	32.0	(-14%)
11.7	(-35%)	2.5	22.0	(-41%)
9.2	(-49%)	2.0	20.0	(-46%)
Transit time				
36.1		16.8	106.2	
32.2	(-11%)	16.2	108.6	(+2%)
35.1	(-3%)	15.9	108.6	(+2%)
36.8	(+2%)	17.3	124.6	(+17%)
29.8	(-18%)	14.7	96.2	(-9%)
26.5	(-27%)	13.3	96.7	(-9%)
Refusals				
4.0		2.9	16.0	
1.7	(-57%)	1.7	11.0	(-31%)
4.0	(-0.4%)	2.9	17.0	(+6%)
3.0	(-26%)	2.3	16.0	(0.0%)
0.2	(-96%)	0.4	3.0	(-81%)
0.1	(-97%)	0.4	3.0	(-81%)

14. CONCLUSION

We present one additional table, Table 15, which directly compares the four interventions when $P = 6$. By comparing Tables 7, 10 to 14, we see that all four of the interventions proposed had a positive effect on most of the performance statistics. Interventions 1 and 4 seem to have no downside. Interventions 2 and 3 seem to occasionally cause a long waiting time for at least some passengers; this deserves further study. Of the four interventions, Intervention 4 showed the greatest improvements compared to the control. Combining all four interventions yields the greatest improvement of all.

One of the author's hypotheses at the beginning of the study was that, with no interventions, the system would experience a large number of refusals, and that these interventions would be effective because they reduced the number of refusals. However, simulation revealed fewer refusals than expected in the control group, and so this is likely not the primary explanation for the success of these interventions. We observed reasonable but not exact agreement between the statistics computed by formulae and those computed by simulation. This has been observed in the literature, and emphasizes the value of simulation.

In future work, we will test the robustness of these results in different scenarios, such as a car going out of service; adding random traffic to this example to allow for building traffic beyond students and instructors traveling to and from class, and to allow for students and instructors who do not take a direct route from their origin to their final destination; and analyzing other examples.

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BIOGRAPHICAL DETAILS

David Swinarski majored in math and English at the University of Notre Dame, graduating in 2001. As an undergraduate he also did research in computational organic chemistry with Olaf Wiest. Swinarski received a Marshall Scholarship in 2000 to study at the University of Oxford in England. He completed his master's degree in 2003 under the direction of Frances Kirwan. He received his Ph.D from Columbia University in 2008 under the direction of Michael Thaddeus and Ian Morrison (Fordham University). He held a postdoctoral research position at the University of Georgia in Athens (UGA) from 2008-2011, where he worked with Valery Alexeev and Angela Gibney. Dr. Swinarski joined the Fordham faculty in New York in August 2011.

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INVESTIGATION INTO THE CLOSING FORCE OF PASSENGER/GOODS LIFT AUTOMATIC POWER OPERATED DOORS AND RECOMMENDATIONS TO REDUCE THE RISK OF INJURY TO LIFT USERS

DANIEL MEEKIN

Keywords: Lift, doors, closing force.

Abstract: Passenger lifts are primarily configured with automatic power operated doors to increase passenger flow efficiency. Injuries caused by impact and entrapment between closing powered lift doors do occur, even though safety devices are fitted which should prevent this happening [1]. There are different types of non-contact safety devices that should reverse a closing door to prevent impacts and entrapments. Innovation in technology has allowed these devices to become more effective. However, the devices still do not eliminate entrapment risks entirely. Additionally, many lifts still employ outdated and inferior devices because within the United Kingdom upgrades to improve safety are not mandatory.

1. INTRODUCTION

With lifts conforming to EN 81-20:2020, risks of entrapments between the closing door still exist due to the non-contact device's narrow infra-red beam. The purpose of which, in accordance with EN 81-20, is still to only detect in the event of a person crossing the entrance during the door closing movement [2]. Within the UK between 2002 and 2010, 266 people had been injured in lift related accidents, with the most common injuries sustained as the doors are closing [1].

A final measure of safety to prevent crushing injuries to passengers is limiting the closing force applied by the door operator. This should be less than 147 or 150 Newtons (N) in accordance with the relevant design standard at the time of installation. (It is also noted that closing forces could vary depending on other door safety features in accordance with BS 2655-1). 150 N is a pragmatic limit. This maximum force, however, is stipulated to prevent injury to lift users and is now a widely accepted figure which is laid down in standards and guidance worldwide to limit the risk of crushing injuries.

Unfortunately, automatic power operated door closing forces may not be routinely tested enough to ensure that forces are below the stipulated limit. There is a consensus that many lifts are in service which exceed the closing force limit due to a lack of routine testing. This project set out to understand if these concerns are valid and to seek areas of improvements for the safety of lift automatic power operated doors.

2. FIELD TESTING RESULTS FROM IN-SERVICE LIFTS

An analysis was completed using data from 48 in-service lifts. This provided 384 closing force measurements in total from different measurement positions. The two measurement positions were: top and bottom of the car door and top and bottom of the landing door. These measurements were taken at the ground floor and one other floor. The measurement positions at one landing are shown in Figure 1. A calibrated, spring-type force gauge with a range of 0 N to 159 N was used to measure the lift door closing forces. It is clear from the data obtained that there are lifts in service with closing forces exceeding stipulated limits. 27% of lift doors applied forces exceeding 150 N at one or more of the test positions. The following paragraphs show trends established during the analysis.

Figure 1: Image of landing and lift car doors showing measurement positions

2.1. DIFFERENCES OF MEASUREMENT POSITION ON THE SAME DOOR

55% of doors have force measurements differing between the top and the bottom. The measured closing force was greater at the top on 91% of these doors. Two conclusions can be drawn from the data. Firstly, the measured closing force of doors does differ depending on the vertical position of measurement. Secondly, where these forces differ between the two measurement positions, peak force in most cases is at the top of the door. This is also confirmed by the average closing forces shown in Table 1. The reason is suspected to be due to mechanical losses when measured further away from the door gear.

Table 1: Average forces comparing different measurement positions

Measurement Position	Average Closing Force (N)
Ground floor - Car door - Top of door	106.1
Ground floor - Car door - Bottom of door	101.6
Ground floor - Landing door - Top of door	105.4
Ground floor - Landing door - Bottom of door	102.7
Top floor - Car door - Top of door	109.8
Top floor - Car door - Bottom of door	103.5
Top floor - Landing door - Top of door	108.1
Top floor - Landing door - Bottom of door	103.4

2.2. DIFFERENCES BETWEEN LANDINGS

59% of the tests have closing force measurements differing between landings. 60% of the measurements are greater at the upper landing where the discrepancies are identified. To confirm this, average measured closing forces are higher at the top floor at every comparison as shown in Table 2.

Most lifts that were tested featured sprung landing door self-closing devices. Therefore, this difference is suspected to be due to the often-increased use of the ground floor and therefore strain to the spring resulting in reduced self-closing forces.

Table 2: Average forces comparing differences between landings

Measurement Position	Average Closing Force (N)
Top floor - Car door - Top of door	106.1
Ground floor - Car door - Top of door	101.6
Top floor - Car door - Bottom of door	105.4
Ground floor - Car door - Bottom of door	102.7
Top floor - Landing door - Top of door	109.8
Ground floor - Landing door - Top of door	103.5
Top floor - Landing door - Bottom of door	103.4
Ground floor - Landing door - Bottom of door	102.7

2.3 DIFFERENCES BETWEEN CAR AND LANDING DOOR

Measured closing forces are the same on 46% of the doors. Where differences of force are identified between the car door and landing door, the position of the highest force is split 53% and 46% respectively. Average closing forces are compared in Table 3. The difference of closing forces between the landing door and car door is negligible and suggests efficient coupling between the landing and car door.

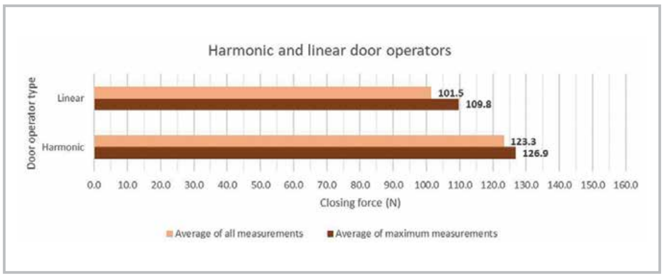
Table 3: Average forces comparing car door and landing door differences

Measurement Position	Average Closing Force (N)
Ground floor - Car door - Top of door	106.1
Ground floor - Landing door - Top of door	105.4
Ground floor - Car door - Bottom of door	101.6
Ground floor - Landing door - Bottom of door	102.7
Top floor - Car door - Top of door	109.8
Top floor - Landing door - Top of door	108.1
Top floor - Car door - Bottom of door	103.5
Top floor - Landing door - Bottom of door	103.4

2.4. DIFFERENCES BETWEEN DOOR DRIVE TYPES (LINEAR AND HARMONIC)

17% of lifts tested utilised harmonic door operators. 50% of the harmonic systems applied a closing force over 150 N and 88% exerted over 100 N. When compared to linear systems the figures are 23% and 48% respectively. The average measured closing force of harmonic operators is 123 N and for linear operators is 102 N. It is reasonable to state that harmonic door operators are likely to apply a greater closing force to lift doors when compared to systems utilising linear door operators. This is suspected to be due to the increased ease of adjustability of linear operators. Figure 2 shows the recorded differences.

Figure 2: Chart comparing linear and harmonic car door operators



2.5. DIFFERENCES BETWEEN SIDE AND CENTRE OPENING DOORS

69% / 31% of lifts tested featured side and centre opening doors respectively. Table 4 shows the average forces of the comparable doors. Harmonic door operators are not included within this comparison because they are mainly coupled with side opening doors within the data, and the type of door operator appears to have the greatest influence on forces as discussed in paragraph 2.4. For those with just linear door operators, it is evident that when configured with side opening doors higher closing forces are applied than with centre opening doors. 21% of centre opening doors applied a closing force of over 150 N compared to 26% of side doors. It is reasonable to confirm that lifts configured with side opening doors are generally set with higher closing forces.

Table 4: Average forces comparing side and centre opening doors

Door opening	Average Measured closing force (N)
Side	109.5
Centre	89.7

3. COMPARABLE POWERED AUTOMATIC DOOR SYSTEMS

Having established safety measures utilised with automatic power operated doors fitted to passenger lifts, it is prudent to investigate other powered door systems in seek of further potential safety improvements. Comparison with other door systems does identify additional measures that could be adopted to further improve lift safety by reducing door entrapment risks.

3.1. TRAIN BODYSIDE DOORS

Power operated doors fitted to trains are similar in principle to those fitted to passenger lifts. With trains, traction power should be inhibited until all bodyside doors are closed and locked. EN 14752:2019 is an 88-page document detailing the safety of bodyside entrances fitted to trains. This compares to 15 pages detailing lift door safety within EN 81-20:2020. Revisions of EN 14752 were published in 2005, 2015, 2019. Amendments to the 2019 document are also available for public review. This demonstrates that improvements to train bodyside doors are actively identified, quickly implemented and therefore safety is continually improved. Comparably, text on lift power operated doors from BS 2655:1970 remains largely unchanged within EN 81-20:2020.

The most basic safety measure used on train bodyside doors, that is not applied to passenger lift power operated doors, is the application of entrapment warning signs. These stickers are fitted to train doors and highlights danger to passengers.

There are some common safety measures shared between the two applications, such as non-contact safety devices which are already discussed. However, train bodyside doors include additional safety features. Some are detailed below:

- Automatic door closing is only enabled when there is nobody in the door portal for a specified time. The door portal is a specified area.
- There must be an audible signal that the doors are about to close, which is standardised to a specific pulse and frequency.
- There must be a visual indication both inside and outside of the train warning that the door is about to close.
- The door control system must contain loops to stabilise forces.
- Detection of obstructions must occur in less than one second.

3.2. POWERED RETAIL DOORS

Retail doors are perhaps the most utilised power operated door within the UK. Facilities usually leave the pedestrian no other option but to enter through the powered door. Risks presented due to high foot-flow through these types of doors are recognised within BS 7036-1, which stipulates that operational safety checks should be conducted periodically by the property occupier. For shops, hospitals and airport settings, these checks should be carried out at least weekly [4]. It is stated that the checks must include operational tests of safety devices and non-contact systems should be tested in accordance with BS 7036-2 [5].

In addition, BS EN 16005 also stipulates that tests of door closing forces 'shall be carried out in the worst conditions and configuration'. Included are locations of where to measure forces [6]. Daily or weekly checks are sometimes carried out on lifts by building occupiers, but this is often just to check that the machine is in service, possibly alongside a test of the in-car alarm/communication system.

Powered retail doors must also display 'keep clear' and 'automatic door' signs to give users advance warning of operation and inform them to keep away from the space where the power operated door travels in accordance with BS7036-0.

4. RECOMMENDATIONS

Simple procedures can be implemented by lift duty holders to improve the safety of lift automatic power operated doors. Building occupiers may carry out daily or weekly checks of the lift, but this is likely to just ensure that the lift is in service, possibly with a check of the car alarm and emergency communication system. It is recommended that checks to the lift doors and their non-contact safety devices are also carried out concurrently, or at intervals recommended by findings from a risk assessment. The checks would not be onerous, but should include a physical check of all landing doors with an operational check of the non-contact safety device. This would be similar to checks required on powered retail doors in accordance with BS 7036-1.

The operation of lift automatic power operated doors has specific risks to the safety of lift passengers. Passengers are either not aware of this or have become accustomed to the risk, possibly because lift use is now largely a necessity within daily life. It is common to witness lift passengers stalling a closing lift door by hand to prevent lift car departure, whether for themselves or to assist other lift passengers. Serious injuries and fatalities have occurred on rail networks due to similar entrapment scenarios. To detract against this practice and to protect train users, warning signs must now be placed at the train bodyside door which highlight the entrapment risk. It is recommended that a similar sign is also applied to lift doors. This would be a simple, cost-effective safety improvement which can be made by the lift duty holder to deter lift users from the practice of stalling closing lift doors by hand.

Improvements to the safety of lift automatic power operated doors can be made to the current design standard, EN 81-20. Progress towards safer lift automatic power operated door systems can be made when compared to the safety of train bodyside doors. EN 14752 contains safety features of train bodyside doors that could be adapted for use with passenger lifts. It is recommended that a review is undertaken to assess the feasibility of these as additional safety measures by BSI.

Modern non-contact safety devices fitted to passenger lifts consist of a narrow beam array fitted to the car door only. This offers limited protection to lift passengers as shown in Figure 3. Fitment of 'light curtain' non-contact safety devices to all landings, in addition to the lift car door as shown in Figure 4 would provide protection against the entire potential entrapment area. This would also protect against door opening entrapments, which is another risk not investigated during this project. It is understood that this would however involve major re-working of surrounding architrave at each landing for existing lifts, but could be incorporated into the design of new installations. The diameter of detected objects should also be reduced from 50 mm (EN 81-20:2020) to a measurement that would detect fingers of children and include the entirety of the closing doorway until the doors are fully closed.

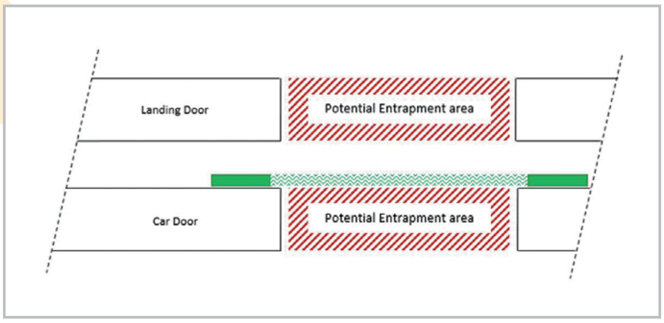


Figure 3: Overhead view diagram of lift door 'light curtain' with common mounting position (indicated green)

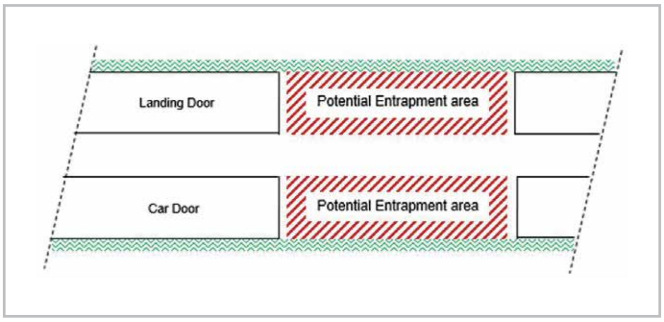


Figure 4: Proposed improvement to door 'light curtain' locations (indicated green)

Passive infrared (PIR) technology could be utilised to better protect entrapment areas of existing lifts. PIR light curtains utilise a single unit and are commonly used within security systems as shown in Figure 5. This technology could be adapted for use at lift landings and due to a single unit, may be a suitable modification to existing lifts because the upgrade would be less intrusive.

Figure 5 PIR intruder detection device [8]

Field investigation has provided data confirming that lifts fitted with automatic power operated doors are in service with door closing forces exceeding stipulated limits. It is strongly recommended that lift automatic power operated door closing forces are routinely checked by the competent person and maintenance personnel.

This investigation has established that a measurement should be taken from the top of the door, at what is assessed to be the least utilised landing. Closing force measurements should also be recorded where there is a change of lift door design between landings, such as foyers of large or extravagant buildings and following replacement of door components.

Closing forces are a protective measure [7] and 150 N is a maximum limit, not a target. It is recommended that lift duty holders carry out a risk assessment with the aim of setting door closing forces as low as possible depending on risk assessment findings. Considerations should include the environment of the lift and the demographic of passengers using the lift.

5. CONCLUSION

Acquiring closing force measurements of automatic power operated doors fitted to in-service lifts has facilitated a better understanding of a problem, whereby force limits exceed stipulated maximum figures. Analysis confirms that many lifts are in service with forces exceeding these limits. Evidence within this paper highlights the requirement for remedial action to reduce or mitigate the risk of impact and entrapment injuries to lift passengers caused by closing automatic power operated doors. Inspection bodies and maintenance providers who assess the safety of lifts should be measuring closing forces during thorough examinations and service visits.

Closing force limits are a final measure of safety to reduce the risks of entrapment injuries and lifts are fitted with safety devices to reverse door closing even before a door contacts the obstruction. Yet, for modern lifts designed to EN 81-20, entrapments can still occur. Improvements can be made to increase passenger safety and further reduce the entrapment hazard. Use of readily available technology and proven safety systems employed with other powered doors can be adapted for lift use to achieve this.

Lift owners and duty holders can take simple steps to reduce the risk of door crushing injuries to passengers. Application of simple warning signs to lifts may deter passengers from using their hands or arms to stall a closing lift door and would be a cost-effective improvement. Additionally, implementing extra checks to the routine testing of lift car alarms such as a functional test of the non-contact safety device and a physical check of the lift doors should also be considered. These measures will reduce the risk of injury to lift passengers and demonstrate a proactive approach to fulfil their obligations to protect the public and workers.

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BIOGRAPHICAL DETAILS

Daniel Meekin is a Senior Engineer for Zurich Engineering UK within their Technical Standards department. This extended abstract is summarized from a dissertation for his Bachelor of Engineering First Class with Honours in Mechanical Systems Engineering completed late 2021.

THE LOGISTICS EQUATION AND FRACTAL DIMENSION IN ESCALATORS OPERATIONS

DR. ALI ALBADRI

Dr Albadri has published more than 20 papers on the subject of using the fractal dimension concept in understanding and maintaining machines.

Abstract: The logistics equation has never been used or studied in scientific fields outside the field of ecology. It has never been used to understand the behavior of a dynamic system of mechanical machines, like an escalator. We have studied the compatibility of the logistic map against real measurements from an escalator. This study has proven that there is a good compatibility between the logistics equation and the experimental measurements. It has discovered a potential of a relationship between the fractal dimension and the non-linearity parameter, R, in the logistics equation. The fractal dimension increases as the R parameter (non-linear parameter) increases. It implies, that the fractal dimension increases as the phase of life span of the machine moves from the steady/stable phase to, double periodic phase to a chaotic phase.

The fractal dimension and the parameter R, can be used as a tool to verify and check the health of machines. We have come up with a theory that there are three areas of behaviors, which they can be classified during the life span of a machine, a steady/stable stage, double periodic stage, and chaotic stage. The level of attention to the machine differs depending on the stage that the machine is in. The rate of faults in a machine increases as the machine moves through these three stages. At the double period and the chaotic stages, the number of faults start to increase and become less predictable. The rate of predictability improves as our monitoring to the changes in the fractal dimension and the parameter R improve.

The principles and foundations of our theory in this work has and will have profound impact on design of systems, and on way of operation of systems, and on maintenance schedules of the systems. The systems, can be mechanical, or electrical or electronics. The discussed methodology in this paper, will give businesses the chance to be more careful at the design stage, and planning for maintenance to control costs. The findings in this paper can be implied and used to correlate the three stages of a mechanical system to more in-depth mechanical parameters like wear and fatigue life.

1. THE LOGISTICS EQUATION

There is no equation in the world of science that has been studied and analyzed as much as the logistics equation $x_{t+1} = R * x_t (1-x_t)$. It is called the logistics equation because it has been used to mathematically model and describe the ecological growth of species. Robert May [1 and 2], is a theoretical physicist extensively studied the logistics equation. He used the equation to describe how single population behave over time. When a population rate of growth increase, its tendency goes to behave in boom-and-bust stages. By trying different values of the non-linear parameter, R, May noticed a dramatical change in the results of the equation. Raising the parameter R, means raising the non-linearity of the equation, which implies that the parameter R, does not change the quantity outcome of the equation, but also the quality of the results.

As can be seen in Figure 1, by increasing the parameter R slowly, the population rises slightly (moving from left to right) in the figure. Suddenly, as the parameter passes R = 3, the line breaks in two lines. This region suggests that the population starts to fluctuate between two values (two points) year upon year the population goes up and down.

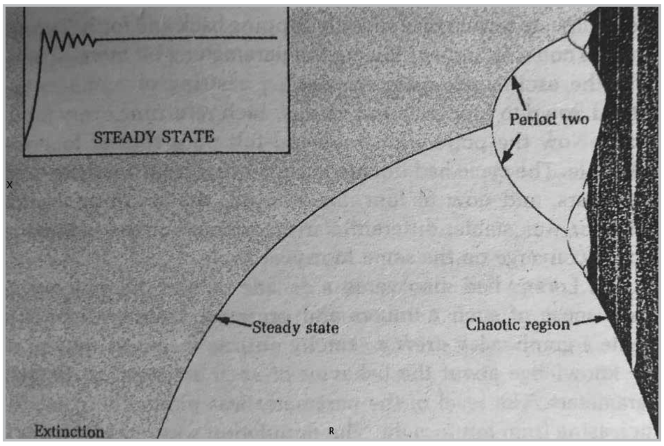

Figure 1 Shows a typical bifurcation diagram for the logistics equation.

Increasing the value of R further, causes the fluctuation to split again, producing string of numbers that settle down to four different values. The cycle has doubled from 1 to 2 cycles, generating Y fork split in the shape of the data. This behavior for the data is called Bifurcation. It implies that the pattern of repetition is breaking down a step further. The period of double fluctuation come faster and faster in a systematic way, 4, 8, 16, 32…in the chaotic region, as R increases. The diagram in Figure 1, is called the Bifurcation diagram or map.

2. THE LOGISTICS EQUATION AND THE FRACTAL DIMENSION (DF)

The repeat occurrence of the double period intervals in the logistics map gave an indication that a hidden fractal behavior has been exposed. The double period intervals show the features of self-similarity or even sim-similarity and scale dependency.

The bifurcation behavior of the logistics equation has unveiled hidden securities, which could have practical implications in understanding the behavior of the dynamics of mechanical, or electrical/electronic systems. The dependency of the equation on the parameter R, is like the dependency of dynamic systems on their initial conditions. An escalator system or a natural phenomenon, like the weather, can behave in a steady stable way within a range of initial conditions. Or, it can fluctuate between two levels, double period interval, in another range of initial conditions. Or, it can have a complete chaotic behavior, embedded within it double period intervals, in another range of initial conditions.

For many years, our focus has been to understand the hidden behavior in dynamic mechanical systems.

Due to the cyclic nature of operation of escalators, we have studied the fractal behavior of escalators in great depth. Our studies were conducted by using our invention, the smart step. We have proven that the data from an escalator have a systematic, repeatable, and consistent pattern of behavior [3].

We corelated the fractal dimension, Df, with the mechanical performance and availability of escalators for passenger service. We have proven that Df can be used to Classify and categorise escalators in ranking, depending on their quality of build, design, and maintenance regimes. We presented a potential of relationship between Df and variables like the maximum and average stress levels in escalator`s step band.

In part 2 of our research [4], we reported the impact of passenger loadings on the fractal behavior of escalators. The fractal dimension values during passenger loading increases by 3% to 10% comparing to the fractal dimension of passenger free escalator. Establishing a relationship between the fractal dimension and the stress levels in the step band is more difficult due to the variability in passenger loadings. Part 2 confirms that the true behavior of an escalator can only be seen in passenger free escalator.

An escalator was divided into regions in part 3 of our research [5]. The fractal dimension, Df, of each region reflects the nature, simplicity or complexity of each region, in relation to the type of the components and sub-assemblies in and around that region. We called it the partial fractal dimension. The partial fractal dimension value of each region can be used as an indicator or a reference to determine the health of the mechanical components and sub-assemblies in that region. It is similar to the overall fractal dimension which can give an indication to the overall health of the machine. The most interesting finding in part 3 of our research is that simple mathematical sum up and average techniques work well with the partial fractal dimension values in determining the overall fractal dimension for all the machine. This methodology or technique has great potential in assessing the health of any mechanical system. The principles behind this work will allow designers and maintainers to quantify and quality the sub-behavior of individual components and sub-assemblies.

Part 4 of our research [6], dealt with the difference in the fractal dimension between machine that has free mechanical defects and machines that have mechanical defects. The machines with mechanical defects tend to have higher fractal dimensions values than the machine free of mechanical defects.

Part 5 of our research [7] has proven that the partial fractal dimension for specific components or sub-assemblies in a mechanical system can be used as a diagnosing tool to identify whether the components or sub-assembly is free of defects or not.

The above series of studies can be deployed to test or verify mechanical, electrical, or electronics systems. It can act as a tool to find out the nature of defects a system might have or could develop during its normal operation.

3. METHODOLOGY USED TO DETERMINE, DF

The scaling step technique has been used to determine Df. A computer program was written in Microsoft Excel to determine Df and plot the data. Our methodology is very similar to the Multiresolution Length Method, which has been used by many researchers [8, 9, and 10].

The technique which used in determining the fractal dimension values have been explained in depth in our previous publications [3, 4, 5, 6 and 7]. They also explain the method which was used to obtain the raw data/measurements from the smart step.

Measurements from eight strain gauges were down loaded from the smarts step after running the step one revolution in the escalator. Figure 2 shows the measurements against time. Table 1 lists the values of the fractal dimension, which have been determined from the measured strains and calculated from Figures 3a, 3b, 3c, 3d, 3f, 3i, 3g and 3h.

Table 1 Shows the values of the fractal dimension from the signals obtained from the smart step.

No.	Strain Gauge	Fractal Dimension, Df	R
1	SG1	1.6997	1.07
2	SG2	1.6366	0.96
3	SG3	1.7522	1.09
4	SG4	1.6126	1.04
5	SG5	1.6886	1.05
6	SG6	1.5815	1.01
7	SG7	1.6909	1.06
8	SG8	1.7738	1.1

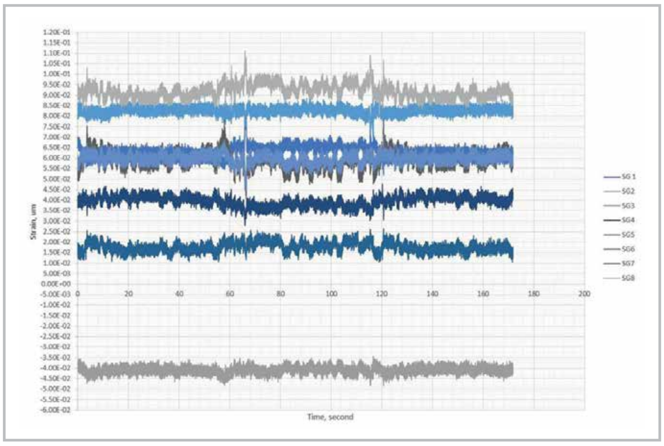

Figure 2 Shows the readings for eight strain gauges from the smart step.

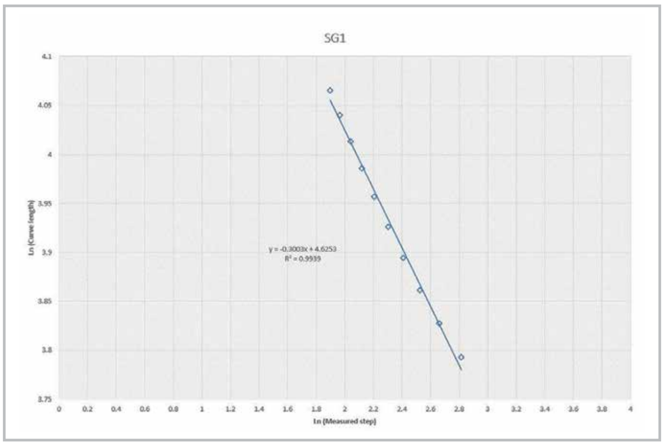

Figure 3a Shows the slope in fractal dimension diagram calculated from the measurements for strain gauge 1.

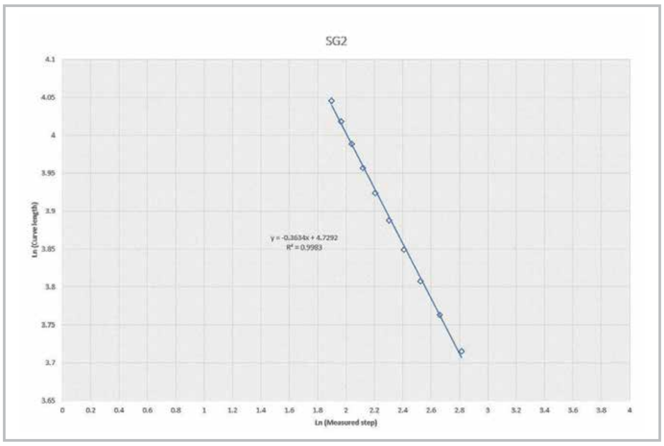

Figure 3b Shows the slope in fractal dimension diagram calculated from the measurements for strain gauge 2.

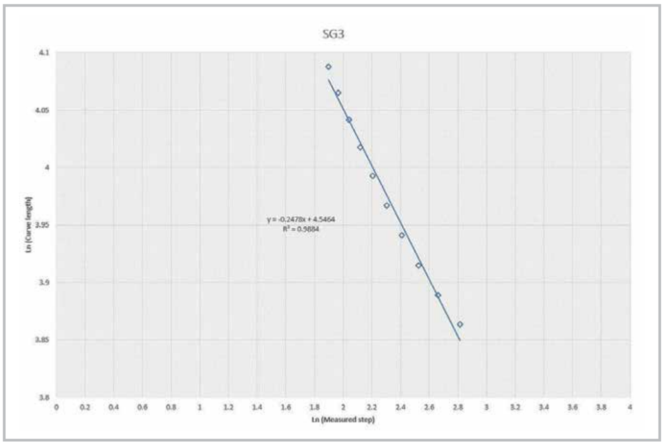

Figure 3c Shows the slope in fractal dimension diagram calculated from the measurements for strain gauge 3.

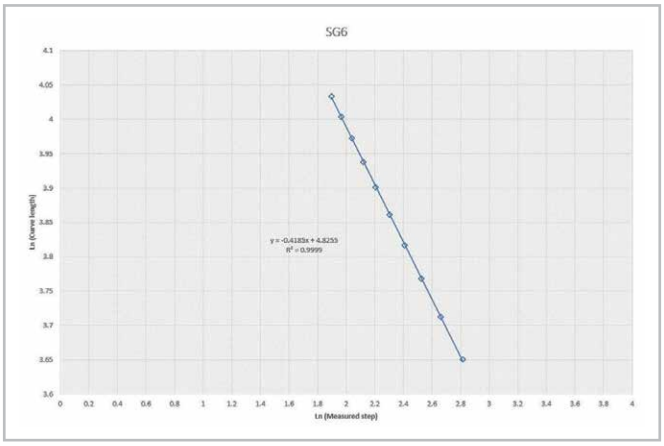

Figure 3f Shows the slope in fractal dimension diagram calculated from the measurements for strain gauge 6.

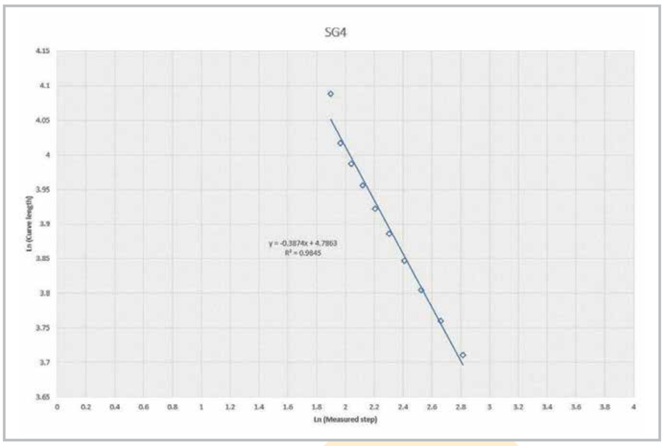

Figure 3d Shows the slope in fractal dimension diagram calculated from the measurements for strain gauge 4.

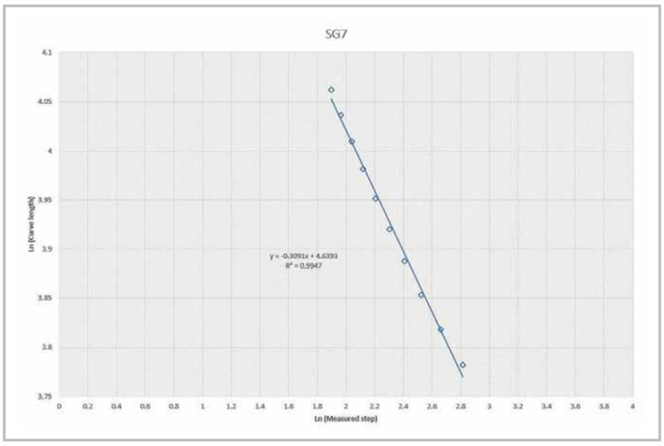

Figure 3g Shows the slope in fractal dimension diagram calculated from the measurements for strain gauge 7.

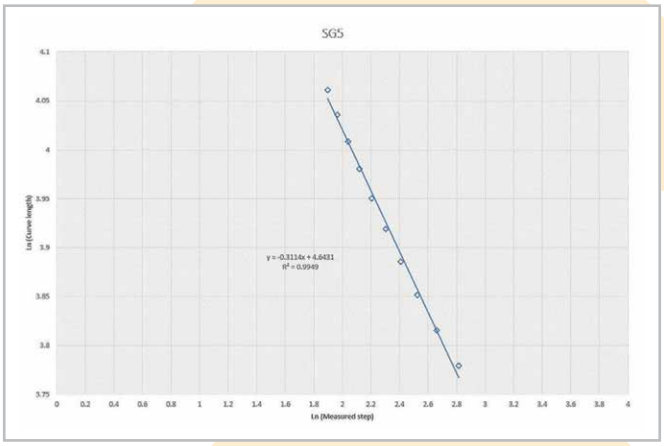

Figure 3e Shows the slope in fractal dimension diagram calculated from the measurements for strain gauge 5.

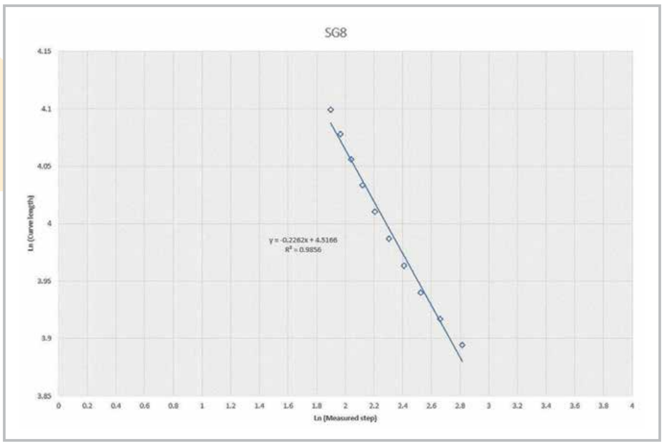

Figure 3h Shows the slope in fractal dimension diagram calculated from the measurements for strain gauge 8.

4. RESULTS AND DISCUSSION

Figure 2 shows the raw data from eight strain gauges which are mounted at different locations on the smart step. The figure shows the variation in the strains along the length of the escalator from running the step one cycle in the escalator. After using an iteration process for the value of R, the data (the checked values) produced from using the logistics equation, they have been plotted in Figure 4. The data from the equation behave similar to the behavior of the measured data, in fact they overlap them as if they are copy to them. For further checks, various scales for the graph in Figure 4 have been investigated as shown in Figure 5. Figure 5 shows the compatibility in behavior between the data from the equation and the measured data. The iteration process for the value of R have produced a specific value of R for each trace. Plotting the values for Df against the values of R in Figure 6, suggests that there is a linear relationship between these two parameters. It shows as the fractal dimension increases the bifurcation parameter (non-linearity parameter) increases.

Figure 7 shows an attempt to plot a bifurcation diagram from the data obtained in this study. The figure shows that as the value of R increases, the cyclic behavior of the data from the stain gauge increases too. If we ignore the first two points in the Figure, the shape of the relationship is likely to indicate that it is linear and not parabola. To understand the long-term behavior of the system, in our case an escalator, we have visualized the function for the system by making a graph in Figure 8. The graph has been constructed by plotting input on the horizontal axis and output on the vertical axis for the measured data. For each possible input x, there is just one output, y, and this form the shapes by the lines in the figure. If we use Mitchell Feigenbaum technique to represent the long-term behavior of the system [8, 9, and 10], we draw a trajectory that start with some arbitrary x, then each y is fed back into the same function as new input, we could see a schematic diagram as shown in Figure 9. Like in ecology, the most obvious function for population growth is linear. But, the more realistic function formed is an arch, parabolic shape, sending the population back down when it became too high, see Figure 10.

The main sensitivity in the two functions, the linear and the parabolic, is the steepness of the curve or the non-linearity. Robert May called this behavior in biology "boom and bust". For mechanical systems, we call it "stable/steady and periodic/chaotic". In the periodic then chaotic stage, the machine inters the stage of developing or having mechanical faults. When the slope is too shallow the fluctuation in strain gets eliminated with time. Any starting strain would lead to zero strain after few fluctuations. Increasing the steepness of the curve produce steady to a point that the strain value becomes nearly one dimensional. Beyond a certain point, a bifurcation produces oscillating signals with double periods. After that the signals move to a stage where they refused to settle down at all.

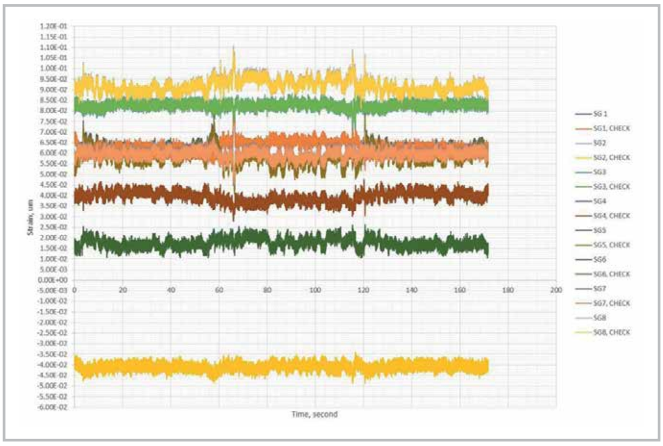

Figure 4 Shows plots for the data obtained from using the logistic equation. They check and overlap the real raw data obtained from the strain gauges. The data obtained from the smart step after one revolution.

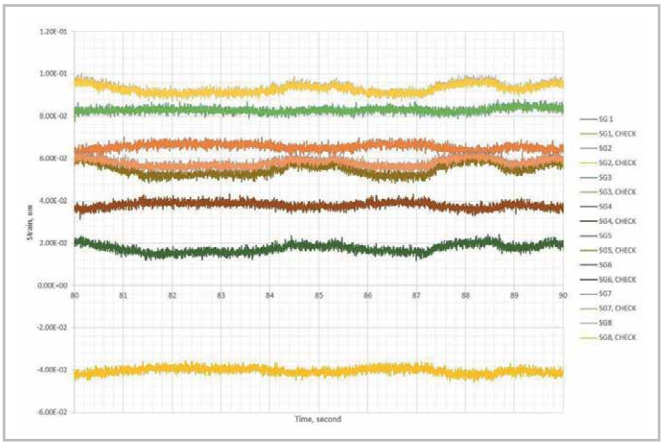

Figure 5a Shows the data from the logistic equation overlap the raw data at scale from 80um to 90um.

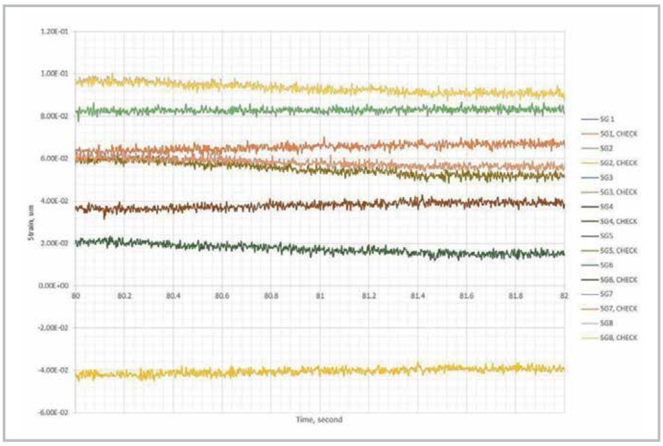

Figure 5b Shows the data from the logistic equation overlap the raw data at scale from 80um to 82um.

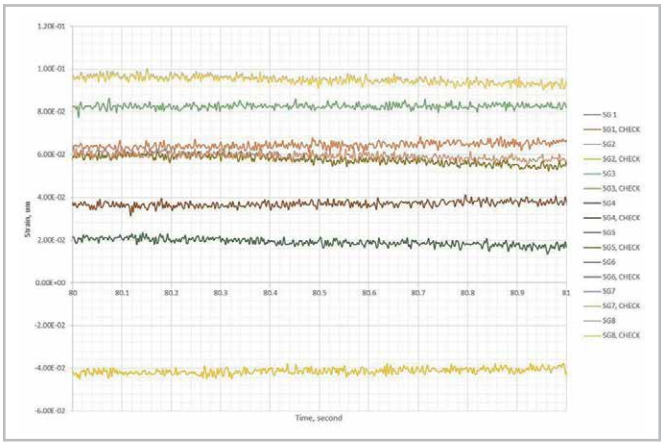

Figure 5c Shows the data from the logistic equation overlap the raw data at scale from 80um to 81um.

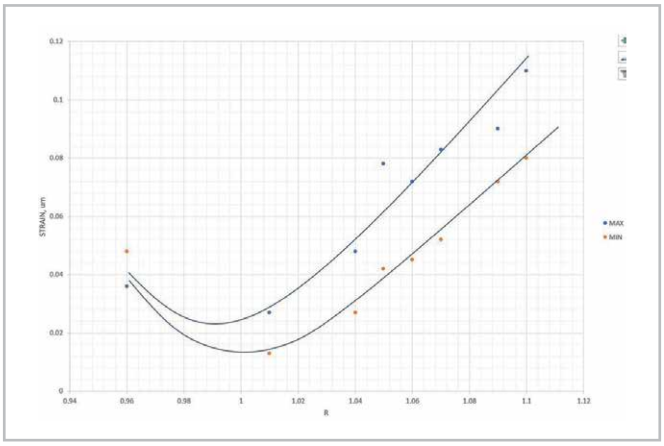

Figure 7 Predicated bifurcation diagram for an escalator.

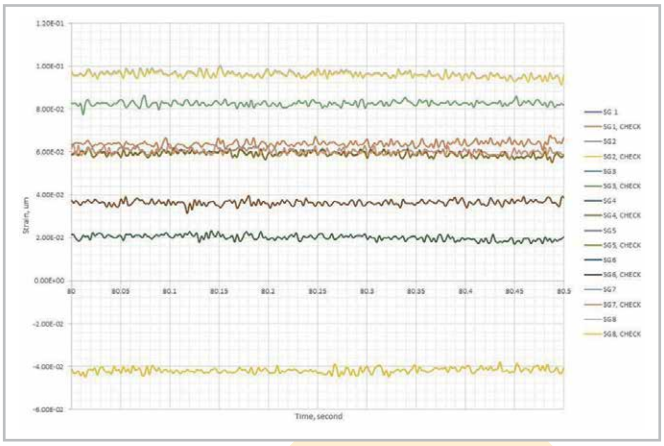

Figure 5d Shows the data from the logistic equation overlap the raw data at scale from 80um to 80.5um.

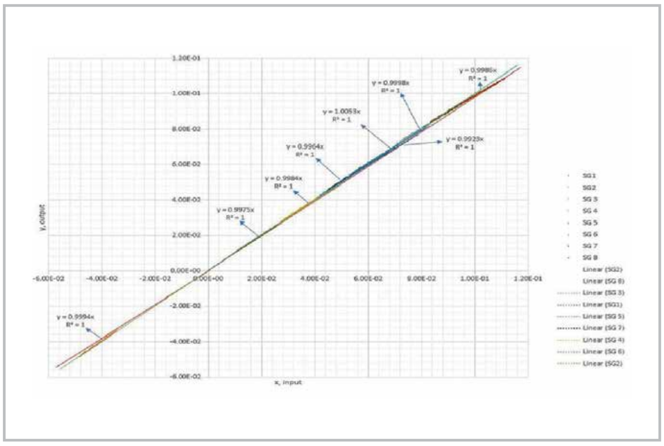

Figure 8 Presents the input against the output data for the obtained raw measurements.

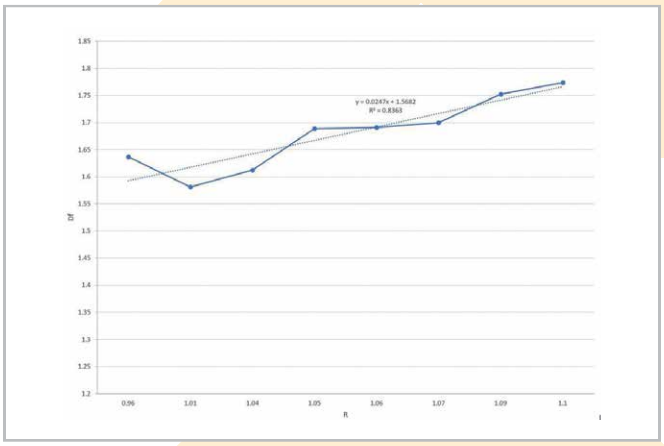

Figure 6 Presents a linear plot for the values of Df against R, shown in Table 1.

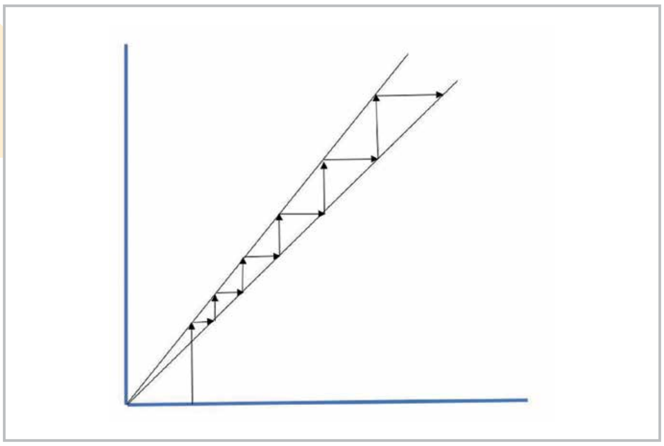

Figure 9 Shows Mitchell Feigenbaum illustration diagram.

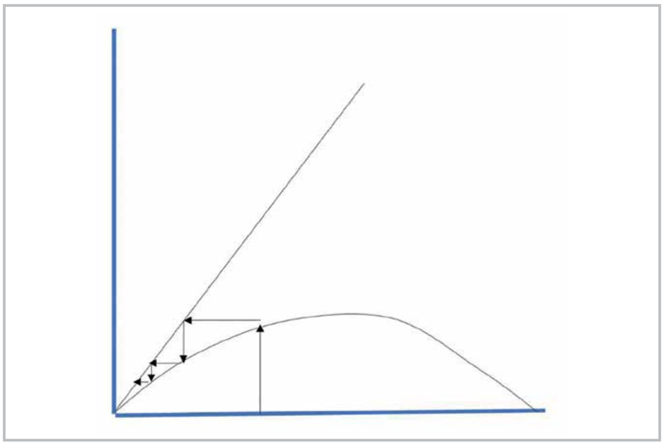

Figure 10a Shows the input and output of the parabolic equation.

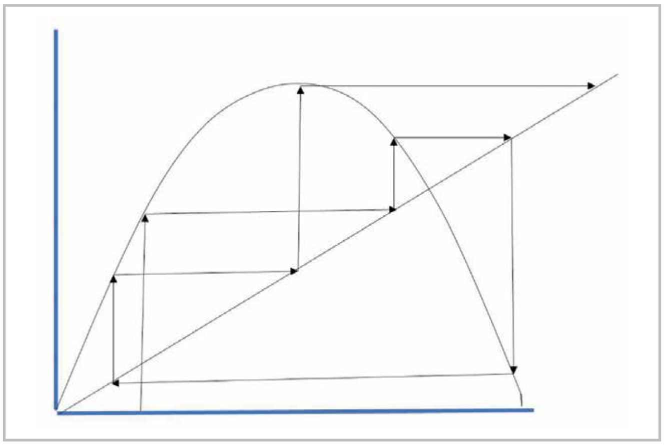

Figure 10a Shows the input and output of the parabolic equation.

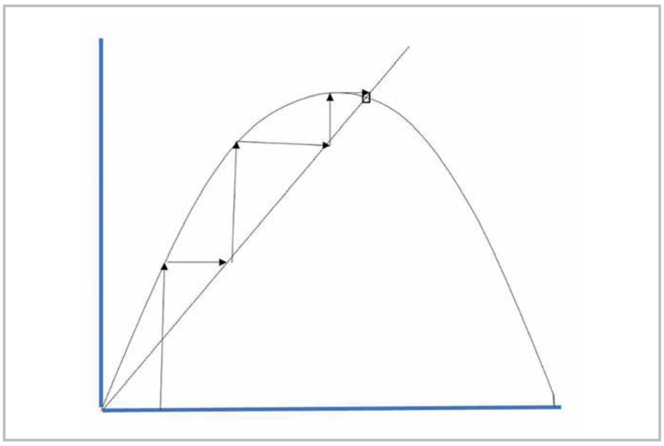

Figure 10b Shows the input and output of the parabolic equation.

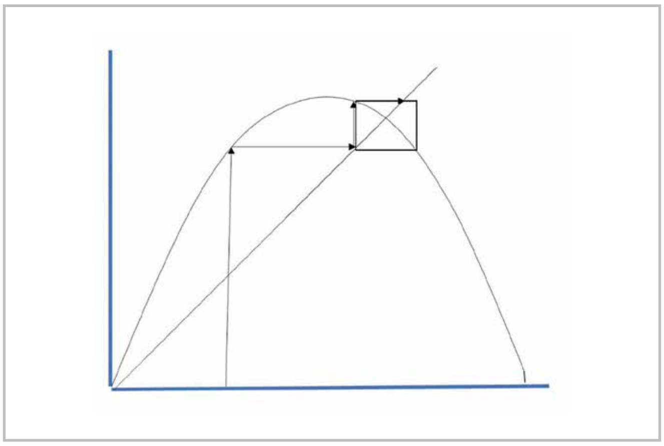

Figure 10c Shows the input and output of the parabolic equation.

5. CONCLUSION

In this study we have tried to construct a theory, it is based on using the chaos theory. After reconfirming the repeatability and consistency of data measured by the smart step, which was run in one revolution in the escalator, we have examined the validity of the logistic equation against our measured data. The logistic equation has produced compatible and comparable results to the measured data from the machine. The data have also shown that potentially there is a linear relationship between the fractal dimension and the non-linearity parameter, R, in the logistics equation. The higher the fractal dimension the faster the system start to move from stable/stead state to a double periodic state then to chaotic state. The fractal dimension value and R value can be indicators to the state of the machine, healthy (no failure), semi-healthy (potential of occurrence of failure), not healthy (fault can occur) at any time. Classifying the operational behavior of a machine into stages, has many advantages not only in maintaining the machine at the right time with the available resources, but on correlating these stages to more in-depth mechanical parameter, such as the wear and fatigue effects that the machine is subjected to during its life span of operation.

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BIOGRAPHICAL DETAILS

Dr Ali Albadri is Chief Engineer at London Underground Ltd. He has worked for UMIST, Brunel University, Oxford University, then he moved to work for various companies. He worked as a Materials Scientist for Cookson Group, Design Engineer for ABB, Senior Design Engineer for Olympus Ltd and Hydronix Ltd, Lead Engineer for Tube Lines Ltd and JNP, then Chief Engineer for London Underground Ltd.

He has a PhD and MPhil in Materials Science from UMIST and Sheffield University respectively. A BSc in Nuclear Engineering and another in Mechanical Engineering from Baghdad University and Technology University, respectively.

He invented and patented many products, such as; the concrete strength devise, the smart step and the smart test rig.

He has published more than 45 technical papers in various subjects, such as Materials Science, Nuclear Radiation, Condition Monitoring for Infrastructures, Interaction between Microwaves and Materials Moisture Contents. In recent years, he published more than 20 papers in the subject of using the fractal dimension concept in understanding and maintaining machines.

His hobbies are swimming and reading.

NEWS FROM THE CIBSE LIFTS GROUP

RICHARD PETERS
Treasurer, CIBSE Lifts Group

Annual Seminar 29th November 2022

The CIBSE Lifts Group Annual Seminar took place on 29th November 2022. The event, coordinated by Gina Barney, provided an opportunity to hear selected papers first presented at the Lift and Escalator Symposium in September, with additional time to go into more detail and discuss the topics.

Session 1 was chaired by Michael Bottomley. Philip Pearson of Pearson Consult Ltd discussed The technical challenges involved in lifting 40-tonne trucks using rigid chain technology in a confined space, Adam Scott of Sweco presented on Energy efficient buildings assessing the impact of lifts, and Gina Barney of Gina Barney Associates addressed Rated load and maximum available car area: a proposal to revise EN81-20, table 6.

Session 2 was chaired by Adam Scott. Paul Clements of D2D presented Exploring IoT applications for vertical transportation (VT) to tackle challenges in a modern world, and Jonathan Beebe of Jonathan Beebe Ltd introduced the Global dispatcher interface - initial prototype design.

AGM and Evening Meeting 16 February 2023

The CIBSE Lifts Group AGM and Evening Meeting will take place at CIBSE, 222 Balham High Road, London, SW12 9BS, on Thursday, 16 February 2023, at 5 pm (registration from 4.30 pm).

The AGM and Evening Meeting are open to all. Free tickets are available at ***https://tinyurl.com/284cbyn6*** or search "CIBSE lifts group AGM 2023".

Nominations for the CIBSE Lifts Group Executive committee, which oversees the activities of the CIBSE Lifts Group, should be sent to ***http://liftsgroup@cibse.org***

Our AGMs are typically about 30 minutes long, followed by the Evening Meeting, which will end at 7 pm. The Evening Meeting will be chaired by Gina Barney, who has arranged two speakers, Matt Davies and Jason Godwin. Their abstracts are as follows:

Digital Switch

MATT DAVIES, AVIRE

The UK telecommunications network is undergoing unprecedented change. The move from copper (analogue) to fibre (digital) telephone lines and the removal of analogue support from the fixed line network has major implications for the majority of tele-alarms currently installed on lifts in the UK. At the same time, changes to the mobile networks will also impact GSM-based systems. The presentation will outline the key telecommunications technology changes & timelines, the implications for existing and new tele-alarms, and dispel some of the myths around certain technologies currently available to our industry.

Replacement of Landlines with Mobile (GSM) Gateways for Lift Emergency Communication

JASON GODWIN

2N Regional Sales Manager

Mobile gateways provide an easy, cost-effective alternative to landlines and have been widely adopted within the lift industry, seemingly without consideration as to their suitability and performance in respect of DTMF signalling. The author presents research on packet loss in mobile communications together with anecdotal industry feedback to suggest a significant percentage of DTMF signals are lost, scrambled, or distorted and a call becomes unintelligible to the receiving party. This paper sheds light on a neglected issue affecting the performance and code conformity of mobile gateways, when utilised as a replacement for landlines in lift emergency communication with respect to DTMF signalling. The author hopes that a wide discussion emerges to better understand the issues.

THE LONDON PLAN

The CIBSE Lifts Group met earlier this year to hear about the London Plan and how it affects the lift industry. Adam Scott, Chairman of the CIBSE Lifts Group and its Code and Standards representative, presented some of the key implications for lift system design, and some recommended actions to ensure clarity for the future.

The London Plan is the overall strategic plan for the city, setting out a framework for spatial development including economic, environmental, transport and social elements for the next 20 to 25 years. Part of each borough's development plan, The London Plan is a legal document, and its requirements must be taken into account as part of the planning decision process; there is an expectation that planning decisions should require compliance. Although it only covers Greater London at the moment, other cities may follow suit in developing similar plans in the future, so it is important that we consider its content with a nationwide view.

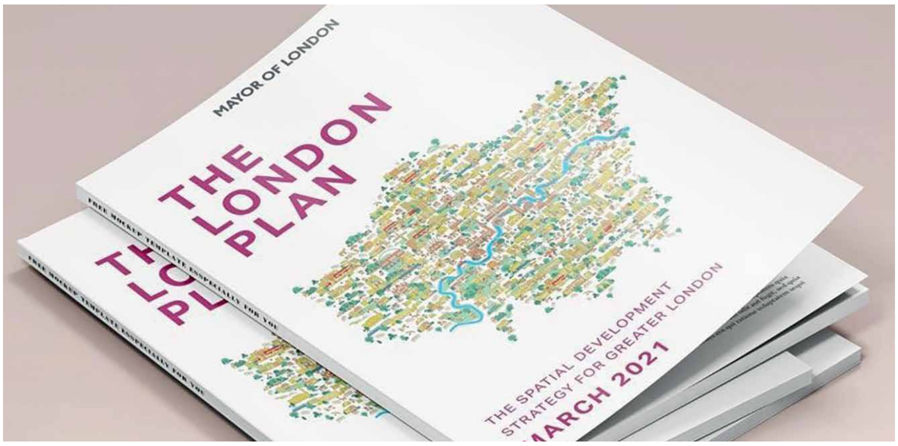
RAISING ISSUES WITH THE LONDON PLAN

London Plan Policy D12 sets out requirements for new developments to achieve the highest standards of fire safety, to incorporate accessible and inclusive design with safe and dignified emergency evacuation for all building users; all laudable goals. In addition, and of particular relevance to the lift industry, London Plan Policy D5 requires developments that include a lift core to include at least one evacuation lift.

The London Plan is supported by a set of London Plan Guidance (LPG) documents which provide support on how to implement the London Plan and how to demonstrate compliance. Many of these LPG documents, including the D5(B5) guidance on evacuation lifts, remain at draft for consultation stage and work has taken place this year to provide feedback from the lift industry to refine and improve the guidance as it relates to lifts.

The draft D5(B5) LPG for evacuation lifts is a very relevant document for the lift industry to become familiar with and readers are encouraged to seek a copy which can be found at:

https://www.london.gov.uk/sites/default/files/draft_guidance_sheet_d5_b5_evacuation_lifts_070720_web.pdf



Key topics in the draft guidance that may cause some discussion and confusion amongst designers are:

- The guidance calls for as a minimum at least one evacuation lift in each "core" but does not explicitly define what a "core" is, i.e. a protected stair core or a core of lifts, or some other measure. Consensus seems to be forming that the intent is for every protected stair core to have at least one evacuation lift, however the Fire Strategy for the building should confirm the precise requirements.

- The guidance calls for evacuation lifts to operate in an automatic mode under the direction of a competent person such as building management or rescue services. As yet however there is no standard approach to this mode of operation.

- The guidance requires evacuation lifts to be in addition to firefighters lifts. This is to ensure that evacuation lifts remain available when the firefighters lift is in use by the fire and rescue services.

- The guidance calls for a "capacity assessment" which may determine a requirement for more than the minimum one evacuation lift per core. There does not yet appear to be a consistent methodology for the capacity assessment nor guidance on who is responsible for its completion.

- The guidance frequently references firefighting lifts rather than firefighters lifts.

- The guidance references "…a suitably sized evacuation lift" with no further comment on what size such a lift might be.

The guidance then also provides a checklist designed to provide planning officers with a method to confirm that the planning application complies with all relevant legislation and the London Plan fire safety requirements. This is to be evidenced via the issue by the applicant (not the lift provider) of a Declaration of Compliance. This Declaration of Compliance has the potential to be confused with the similarly named Declaration of Conformity, with which our industry is so familiar.

The London Plan is the overall strategic plan for the city, setting out a framework for spatial development including economic, environmental, transport and social elements for the next 20 to 25 years.

The LPG provides further guidance on evacuation lifts within residential developments where there may be no onsite management. In this instance, with no competent person able to use the evacuation lift in driver-assisted mode, there must be an alternative, such as the automatic mode, mentioned earlier, or a remote-assisted mode, which has previously proved problematic when proposed by the draft prEN 81-76.

Appendix B of the LPG references the relevant British Standards for evacuation lifts and firefighters lifts. Reference is made to the forthcoming BS EN81-76 for evacuation lifts but until this is published designers should comply with the recommendations of the BS 9991 and BS 9999 codes of practice when designing evacuation lifts, and BS EN 81-72 for firefighters lifts.

One thing that is missing from this list of key features, that appears in the standard BS 9999, is the requirement for an evacuation lift to be in a protected enclosure – one of the reasons why historically a firefighters lift has been such a great candidate for an evacuation lift, as it is always provided in a protected enclosure. Selecting passenger or goods lifts as evacuation lifts can create some additional issues. Front-of-house passenger lifts would need protected lobbies at all served floors and need enhanced communication panels and signage in the aesthetically sensitive lobbies. Where goods lifts are proposed as evacuation lifts the recommendation in BS 9999 for evacuation lifts to also comply with the accessibility standard BS EN81-70 can create some design conflicts, e.g. handrails. It is however likely to be easier to provide goods lifts in protected lobbies than front-of-house passenger lifts.

RESOLVING ISSUES WITH THE LONDON PLAN

As an industry we should continue to work with the Greater London Authority to improve the draft D5(B5) LPG for evacuation lifts. This dialogue should be delivered in conjunction with the work currently underway on the development of the evacuation lift standard EN81-76, and the new BS 9991 code of practice for fire safety in residential buildings.

In terms of the immediate challenge for the lift industry to respond to the London Plan requirements, the author believes we should focus on the fact that we supply lifts. The industry should not be drawn into determining the number of evacuation lifts required, their location or capacity, but look to other competent designers to define the project-specific requirements for both firefighters lifts and evacuation lifts.

As always, the reader is encouraged to seek out opportunities to review and comment on draft legislation and standards that affect our industry. Bodies such as the CIBSE Lifts Group (CLG) seek to promote draft standards at comment stage and encourage members to share their expertise through constructive comments. Should the reader have any questions on the London Plan, or indeed other standards, they should contact the CLG at

https://www.cibse.org/get-involved/special-interest-groups/lifts-group/contact-the-lifts-group

BIOGRAPHICAL DETAILS

Adam started his career in the lift industry 31 years ago with Otis in London, UK. After twelve years working in construction, service, modernisation and new equipment sales, he moved into the world of consultancy with Sweco (formerly Grontmij and Roger Preston & Partners) and has subsequently worked on the design of vertical transportation systems for many landmark buildings around the world.

Adam is the current Chairman of the CIBSE Lifts Group and of the CIBSE Guide D Executive Committee. He is the current codes and standards representative for the CIBSE Lifts Groups and sits on the British Standards Institute MHE4 technical committee. He is also a member of the BCO vertical transportation technical peer review committee. Adam is currently also the UK nominated expert for WG7 dealing with the accessibility standard EN81-70.

LETTER FROM AMERICA

The ADA is the Americans with Disabilities Act. It is a national law that was created in July of 1990 and became effective in July of 1992.

When one thinks of the US lift market, one immediately thinks of New York City. New York has been the home of high-rise buildings for more than 100 years. The 102 storey Empire State Building has been a part of the city's skyline for over 91 years.

However, most in the lift industry outside the US are surprised to learn the size of the low-rise lift market in the US.

Twenty-five percent of the lifts installed in the US in the last year were two and three stop units, and over half of these were hydraulic. Additionally, the smallest lifts have a capacity of 953 kg.

THE QUESTION MOST OFTEN ASKED IS, "WHY ARE SO MANY LARGE LIFTS INSTALLED IN SUCH SMALL BUILDINGS?"
The answer is the ADA.

The ADA is the Americans with Disabilities Act. It is a national law that was created in July of 1990 and became effective in July of 1992.

The law requires virtually all new buildings being built and existing buildings being modernized to comply with this law. Any such building over one storey and open to the public is required to have a lift with a **minimum** size of 953 kg. Additionally, all existing lifts, regardless of size, required various upgrades.

Obviously, this law was very well received by the lift industry.

The following are a few examples of buildings required by ADA to have lifts:

- A restaurant with a banquet room on the second floor that is used only for special events.
- A place of worship (church, synagogue, mosque, or temple) with a meeting room on a second floor.
- An automobile dealership with a second floor.
- Hotels.
- Office buildings.
- Schools.

The goal of this law is to eliminate discrimination. Ambulatory lift passengers usually turn and face the front of the lift after entering the lift. It would be considered discriminatory if a passenger in a wheelchair could not do the same. For that reason, the cabin interior must permit someone in a wheelchair to enter the lift and then turn and face the entrance. The turning radius of standard wheelchairs requires an interior area that equates to a **minimum** capacity of 953 kg.

Adding a lift to a two or three storey building represents a large cost for a building where the lift will rarely be used. For that reason, building owners and contractors are looking for the lowest cost lift that complies with the ADA. In most cases, a hydraulic lift has been selected.

Over twenty years ago, when the traction MRL was introduced, many predicted the hydraulic lift would disappear. However, this hasn't happened in the US.

The advantages of the traction MRL were touted as:

1. No machine rooms.
2. No use of hydraulic fluid that could contaminate water supplies.
3. Lower energy consumption.

Initially, hydraulic lift manufacturers, including three of the large multi-nationals, competed with the traction MRL based on initial price and lower maintenance costs. Energy was never a big factor in the low-rise market because lifts that rarely operate don't use much energy.

It should be noted that the multi-national lift manufacturers offered traction MRLs for clients who preferred an MRL.

Today two of the multi-national companies offer MRL hydraulic lifts. These units use biodegradable vegetable oil hydraulic fluid, have small lift well dimensions because no counterweight is required, and have less environmental impact when calculated based on a Life Cycle Analysis (LCA).

Because of ADA, the 2 and 3 stop lift will continue to be a major part of the US market.

Because hydraulic lifts offer a lower cost solution for the low-rise market, they should be around for a while longer.

ACKNOWLEDGEMENT
I want to thank Peter Engwer, National Director – Major Projects & National Accounts, TK Elevator USA for sharing with me information about the US lift market.

RORY SMITH
Rory Smith is Visiting Professor in Engineering/Lift Technology at the University of Northampton. He has over 53 years of lift industry experience during which he held positions in research and development, manufacturing, installation, service, modernization, and sales. His areas of special interest are Robotics, Machine Learning, Traffic Analysis, dispatching algorithms, and ride quality. Numerous patents have been awarded for his work.

ELEVATOR PITCH

For this issue we find ourselves at the iconic Blackpool Tower, ready for a proper tourist experience. A short 69 second ride to the top of the 518ft tall tower, it's a classic British institution, with spectacular views over the Irish Sea and Blackpool itself. I'm meeting Mark Harding for this trip, founder of Ascension Lift Solutions and creator of the Lift Industry Mental Health Charter.

DOORS CLOSING, GOING UP...

CAN YOU TELL ME A BIT ABOUT YOUR JOB – WHAT DO YOU DO?

I started in the lift industry in 1999 as an apprentice to a fitter, before doing my qualifications and working my way through the ranks to Director of both Abbey Liftcare and PDERS until July this year when I set up Ascension Lift Solutions, a lift consultancy providing advice and training. I also recently set up the Lift Industry Mental Health Charter.

TELL ME ABOUT A RECENT OR FAVOURITE PROJECT AT WORK – MAYBE SOMETHING THAT YOU'VE SEEN HAVE A GREAT IMPACT.

Starting my business from scratch is my greatest achievement this year – there are things I thought I knew - and didn't - and things I've had to learn along the way. You really have to know everything, setting up a business! Another proud achievement is creating a Lift Industry Mental Health Charter YouTube channel which we're starting to put videos on to cover specific topics.

Ted, new addition to the family, Mark recommends a dog for your mental health!

Congratulations to Mark's son Rhys who won gold in the National League Trampolining finals in November 2022.

TELL ME MORE ABOUT LIFT INDUSTRY MENTAL HEALTH CHARTER AND WHY IT'S SO IMPORTANT.

I had experience in organising courses to support mental health, and recognised the importance and the need for helping people in the lift industry. I've been impacted by my mental health, and I've found that if you're open about it, other people are as well. It's a wider issue than you might think - people have problems with things like sleep, overthinking and anxiety. I didn't realise how many people are impacted by poor mental health, this process has been eye opening, just giving a forum for people to open up. We're looking at holding Charter events next year – a climb in Snowdonia and a wellness event, as well as football matches.

HOW DO COMPANIES SIGN UP?

It's really straightforward to join – just send an initial communication through the dedicated website, I'll ask for your company logo, and once it's on the website, you're part of the charter. There are commitments on the website to aim for, which companies can use to help them with their mental health support journey, and I'm adding documents to the website all the time to help companies with their commitments.

WHAT DO YOU ENJOY DOING OUTSIDE OF WORK?

I have a keen interest in cars, I go to a lot of meets, and I did a roadtrip earlier this year, including a trip to the Nürburgring – I did just one lap! I like travelling and exploring new places, this year I've climbed Ben Nevis and swam/fell in Loch Ness!

WHAT'S THE BEST GIFT YOU'VE EVER BEEN GIVEN?

When I was younger, it was a remote control car – the classic best kids' gift! As an adult, it was a driving experience – that was a good gift!

WHAT'S YOUR FAVOURITE PIZZA TOPPING?

Texas BBQ or a meat feast!

IF YOU COULD HAVE ANY SUPER POWER, WHAT WOULD IT BE?

Either invisibility or being able to fly – I'm not sure between the two. Probably being able to fly – it's a bit less creepy!

WHAT'S YOUR FAVOURITE LIFT?

The best thing I've ever worked on, as an engineer, is a Schindler Transtronic. It's the only time I've ever seen them, or worked on them, in Guys Hospital before the lifts were modernised. There were very few left, and so it was a privilege to work on them, a great challenge. Although I'm not sure I should have a favourite lift!

And here we are, ready to take in those incredible views, and maybe head out onto the glass floor to peer down at the promenade below, if nerves allow!

You can find out more about the Lift Industry Mental Health Charter at ***http://liftmentalhealthcharter.com***.

*The **Lift Industry** Mental Health Charter*

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Use of hydraulic & MRL lifts	Add £495.00

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LETTERS FROM THE PIT

John is Lift Industry News' very own agony uncle and is here to support you when your vertical transportation relationship is going through a bad patch.
WISH TO ASK JOHN A QUESTION »
www.liftindustrynews.com/dearjohn or scan the QR code.

"IS IT TOO EASY TO ACCESS LIFT SHAFTS?"

Ben from York is concerned about the risk associated with standard release keys.

DEAR JOHN

In my opinion, it is far too easy for the public to access a lift shaft. Perhaps it is time to require a site-specific, secure key instead of the current standard release key. Yes, it will be less convenient for us, but it would save lives. Do you agree?

JOHN SAYS

Thank you for this pertinent question. The short answer yet again from me is no. A quick trawl of Amazon or Ebay will offer up any number of different lift door release keys which to those wishing to use them for alternative tasks other the lift maintenance makes them readily available. My opinion is that the industry has gone too far now to retrieve a situation we should have addressed many years ago using some of the options below and by forming a register whereby keys could be numbered and only issued to authorised people. Yale does this quite successfully on 1000's of commercial locks.

Having worked for H&C Lifts (now TKE owned) in my formative years, our company developed a release key system that was secure and to a degree fool proof. It also quite often baffled the fools who were fitting them too ☺. Express Lifts (RIP) also made a very good release mechanism which was, initially numbered with each key registered.

H&C Express *GAL*

The 'drop down' release key was systematically replaced in the 1970's and 80's with the now common 'Euro' key which has been ubiquitous in mainland Europe for many years. GAL, being US-made, is the proud exception. The import of European package lifts and then changes in standards led to the almost rare installation of the better protection afforded by the 'drop down' keys I referred to. There have also been some less common but equally 'secure' keys.

GAL VR *Rolesecure* *Euro*

The GAL VR key below is a good example and the Rolesecure (Lowe and Fletcher) was popular with local authorities although not quite as robust as some landing locks required.

However when all said and done standards dictate the Euro key to be the norm. The situation is now almost irretrievable given the numbers fitted across the UK alone. Therefore, we are left with the dilemma of making entrances safe despite the euro key. This has been tried with CAT 2 solenoid devices, anti-surfing devices, hidden escutcheons or key locked 'plugs' in the escutcheon. All of these devices have the potential to save the lives of those choosing to enter a lift shaft by unauthorised means. But let's be frank, not every motorway bridge has a cage over it, nor every tube station platform has secondary doors fitted, those with intent will usually find a way. The best we can hope for is improved access security to buildings which in my humble opinion is the best solution. This would see a return to residential caretakers (the clue is in the name) along with concierge and lobby captains whose presence is commonplace in the US, Australia, UAE etc. **There is scope for further debate and possibly some innovative solutions. At my advancing years, I would like to see critical responses to the above.**

"IS THERE AN EASY GUIDE FOR LIFT OWNERS?"

Brenda from Bath thinks she needs to know a bit more about her lifts.

DEAR JOHN

I run a residential home with two lifts. We have a local lift company who service the lifts and fix them when they break down. I suspect I ought to know a bit more about our lifts, in particular our legal obligations, and how to tell if there is a problem that needs to be fixed – they do rattle a lot, and sometimes the lift does not line up with the floor. Is there a "Dummies guide" to owning a lift?

JOHN SAYS

First and foremost, from your description above and given the vital importance of lifts and lift safety in residential care homes my first thoughts are you may wish to engage the services of a competent lift consultant to inspect your lifts and report on their condition. Rattling and poor floor levelling can be strong signs of poor maintenance or lifts that are beyond reasonable levels of adjustment, quite often it's a combination of both.

The HSE do publish some guidance on lifts, the most helpful would be Thorough examination and testing of lifts – Simple guidance for lift owners ***https://www.hse.gov.uk/pubns/indg339.pdf***. This will guide you through the legal requirements of owning a lift but not necessarily the issues you seem to be experiencing.

To my knowledge, there isn't a UK 'Dummies guide' to lift ownership which leads me to reiterate my point regarding an independent consultant and also relying on your LOLER inspection reports (see the HSE guidance advised above) which should be reviewed by you as a lift owner alongside your service providers to ensure the lifts remain in a safe condition to use. A major point to consider is trust in your local lift service provider. It is fair to say the lift industry has its share of very good companies and some not so good and plenty of choices in between. Also note being a member of trade associations is not always a guarantee of employing a good quality provider.

A quick trawl of Google can lead you to any number of documents, advice and companies all offering exemplary service and tips on lift ownership. But beware, websites can easily mislead, and local recommendation is by far the best route to follow. If you have doubts maybe contact other businesses in your locale that own lifts and seek a good reference.

Owning a lift is quite like owning a car in so much as when you first purchase it the best way to maintain it and keep warranties in place is to have faith (and a contract) with the original installation company. If you have inherited lifts during a property acquisition (the analogy being buying a second-hand car) this is sometimes not possible, and you may need further expert advice. Once again this would point to an independent advisor in the form of a consultant.

Without knowing your exact location it would be difficult to recommend an individual to you and don't be surprised to learn that the quality of consultants can also vary immensely. Some are brilliant and some are not so, some are failed salesman, some are excellent technicians and some well versed in all aspects of the industry. If in doubt contact LEIA (Lift & Escalator Industry Association); whilst lift consultants are not allowed membership of the association many of the team there are familiar with the good guys and the bad guys. They should be able to help.

Even if a 'Dummies guide' to lifts existed I would never advocate having a go yourself at any form of lift maintenance. Lifts can be very dangerous and apart from keeping them clean inside and out, the rest should be left to a competent and honest person. Good luck in seeking one out in the lift industry ☺. If you find one, please let me know.

JOHN BENTLEY

John is an established professional within the lift industry, with over 42 years of varied management and technical experience with a specific interest in quality service delivery, sympathetic lift modernisations where viable, and the development and adaptation of modern technology and design installed in existing environments.

His career started with H&C Lifts/Dover Elevators (USA) and in 1998 he established his own contracting business, trading as ANSA Elevators Ltd. – now recognised as one of the leading independent lift engineering companies in the UK. Since 2015 he has been part owner of LECS (UK) Ltd employed as a Director and Project Engineer covering all aspects of building transportation design and maintenance. He provides the company with all lift traffic analysis support along with expert witness information gathering and reporting.

John believes you never stop learning, so is currently studying Lift Engineering at the University of Northampton.

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