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DANIEL MOIR
OVERVIEW

Welcome to the summer edition and our first birthday of Lift Industry News

I am delighted to be invited to be the Guest Editor for the fifth edition of Lift Industry News, and congratulations to the magazine on their first birthday!

For me, as Chief Operating Officer of the SOE (Society of Operations Engineers) some crystal ball gazing comes with the territory. Like many of us we watch closely the growth of AI and I will be reading with interest Richard Peters' view on this fascinating and challenging subject in the Education Update (Page 13) as well as Rory Smith's paper on the Effect of AI on Service Operations (page 57).

AI is a fascinating subject for the entire engineering community. The continuing development in this area opens up a world of opportunity and there is no doubt it will transform the way we work, however it is important we recognise that humans will always have a part to play and adequate training and support needs to be provided. This can prove difficult in such a fast moving environment which is why adequate safeguards are so important and expertise is sought when putting them in place.

As well as looking forward it is good to remember the proud heritage of the lift industry and Steve Comley from the Elevator Museum in Massachusetts gives an insight into a unique part of industry history on page 32

SOE is the professional home for around 16,000 members working to inspect, maintain and manage the equipment and machinery which keeps people and businesses safe on a daily basis. We are a Professional Engineering Institution and registered charity, and our members work to implement smarter ways of working, improve maintenance and inspection processes, and embed environmentally friendly and sustainable engineering practice. SOE actively champions the next generation of engineers and is passionate about making a global difference to the world around us.

It is also good to hear about the Lift Industry Mental Health Charity and the money raised at the first ever football tournament. Read the match report on page 41. Talking of firsts, ILE held their first ever Car Fest and raised money for the Lift Industry Charity. As a society heavily involved in transport this was a great article to read! (page 44)

Our members have a diversity of backgrounds and characteristics that maximise the talent available to operations engineering so it was interesting to learn more about Omar Marfoua, Specialist Lifts & Services Manager at Shorts, whose 30 year long career in the industry is a great model to others coming up through the industry. Omar gives his Elevator Pitch on Page 82.

Here at SOE we are excited about the future, we are introducing an improved membership offer and increasing our professional development opportunities whilst also providing guidance and standards on new technology. We also continue to support the lift industry through our Professional Sectors the IPlantE (Institute of Plant Engineers) and BES (Bureau of Engineer Surveyors). These Sectors represent best practice in relation to safety and standards and our members continue to uphold the best interests of the industry.

It was an honour to be asked to act as guest editor for this edition of Lift Industry News and I hope you enjoy the magazine.

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lift Industry News

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THIS QUARTER

After one year of Lift Industry News we look to an exciting future!

Happy Birthday to Lift Industry News,
we published our first edition in July 22. Thank you to all our supporters, readers, subscribers, contributors, advertisers **– we couldn't do it without you!**

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lift Industry News

CALENDAR 2023

August 22 - 24 Tues to Thurs

Global Lift & Escalator Africa
August 22-24
JOHANNESBURG, SOUTH AFRICA

October 17 - 20 Tues to Fri

Interlift
October 17-20
AUGSBURG, GERMANY

December 05 - 06 Tues to Weds

International Elevator & Escalator Symposium
December 5-6
EDINBURGH, SCOTLAND, UK

September 04 - 07 Mon to Thurs

Lift City Expo Jeddah
Sept 4-7
JEDDAH, KSA

November 08 - 10 Weds to Fri

International Lift Expo Korea
December 8-10
GYEONGGI-DO, KOREA

December 07 - 09 Thurs to Sat

Vietnam Elevator Expo
December 7-9
HO CHI MINH CITY, VIETNAM

September 20 - 21 Weds to Thurs

Lift & Escalator Technologies Symposium
September 20-21
NORTHAMPTON, UK

November 15 - 17 Weds to Fri

Global Elevator Exhibition
November 15-17
MILAN, ITALY

October 16 - 20 Mon to Fri

CTBUH International Conference 2023
October 16-20
SINGAPORE

November 21 - 22 Tues to Weds

LiftEx 2023
November 21-22
LIVERPOOL, UK

/2024

February 01 - 03 Thurs to Sat

Lift City Expo
February 1-3

CAIRO, EGYPT

March 02 - 04 Sat to Mon

Cairo Liftech Show
March 2-4

CAIRO, EGYPT

May 09 - 11 Thurs to Sat

Inelex
May 9-11

IZMIR, TURKEY

September 16 - 18 Mon to Weds

The Elevator Show
September 16-18

DUBAI, UAE

October 01 - 02 Tues to Weds

E2 Forum
October 1-2

FRANKFURT, GERMANY

December 04 - 06 Mon to Weds

Lift Expo Italia
December 4-6

MILAN, ITALY

December 05 - 07 Thurs to Sat

International Sourcing Exposition for Elevators and Escalators
December 5-7

MUMBAI, INDIA

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.

https://www.liftsymposium.org

BOOMING CONSTRUCTION MARKET IN EGYPT

With two trade shows hard on the heels of each other, Egypt has to be considered one of the fastest-growing economies nowadays. At the crossroads between the Mediterranean Sea, Africa and the Middle East, the growth momentum in the construction industry is expected to reach EGP 721.0 billion by 2027. The tallest structure in Egypt is the Iconic Tower at a height of 393.8 m (1,292 ft) in the New Administrative Capital. It became the tallest building in Africa in October 2020 after surpassing 250 metres and is expected to be fully completed this year.

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ARTIFICIAL INTELLIGENCE

RICHARD PETERS ASKS IF WE SHOULD BE WORRIED

Artificial intelligence (AI) is a term that refers to the ability of machines to perform tasks that typically require human intelligence, such as understanding language, recognising images, making decisions, and learning from data. AI is one of the most exciting and rapidly evolving fields of computer science, with applications in almost every domain of human activity.

AI can be divided into two main categories: narrow and general.

Narrow AI is the type of AI we encounter daily, such as voice assistants, search engines, facial recognition systems, and self-driving cars. These systems are designed to perform specific tasks well but cannot handle tasks outside their domain. In our industry, for dispatching problems (deciding which lift serves which call), we have applied fuzzy logic, neural networks and genetic algorithms; for lift planning, we have used expert systems. Machine learning, applied to lift service and maintenance, promises to improve reliability and customer satisfaction while reducing costs.

General AI is a form of artificial intelligence that aims to replicate human-like intelligence, including abilities such as reasoning, creativity, and common sense. This ambitious goal has been a long-standing research objective for developers. Still, it remains distant, as creating genuinely autonomous systems that can learn and adapt to any situation is very challenging.

Kai-Fu Lee, AI expert and venture capitalist, said, "Artificial intelligence will be the ultimate job disrupter. It will change every job, eliminate some, enhance others, and create entirely new categories of work that we haven't even imagined yet."

Do we, as a lift industry, need to be worried about our jobs?
I asked Google Bard and OpenAI ChatGPT to write me a lift simulation program. They both provided a page (less than 100 lines) of well-written code; very simplistic, but I was still impressed. I am not concerned about my job but have started using AI to speed up simple programming tasks.

AI will write a simple lift specification for you, but I do not believe lift consultants will be redundant soon! Increasingly I use AI to provide drafts for letters, specification sections, and other documents. I used it to help write the opening of this article.

For emergency calls, you can imagine that when you use the alarm button on a lift, the call will be answered by a human-sounding AI which will screen your call before passing the request for action by other systems – which may or may not include human intervention.

AI won't maintain or repair a lift for you, although if you combine General AI with robotics, you can see that it might have some role in the future. Now a humanoid robot can do a backflip - search online if you have not seen this - it is not too hard to imagine a robot doing basic tasks. We can be confident that AI will increasingly play a supporting role in diagnosing problems and identifying tasks that need to be done.

Wanting some pictures to accompany this article, I asked OpenAI's DALL·E 2 to create "a photograph of the London skyline with additional futuristic high-rise buildings and flying cars" and "a human-like robot in an elevator shaft inspecting the elevator ropes". Skilled designers need not be worried yet!

Recent advances in AI have been impressive, and they have the potential to revolutionise numerous industries and domains. I anticipate we as an industry will continue to grow, providing more products and services to a higher standard rather than doing the same thing with fewer people.

If you are interested in AI and some of what the future holds for us in the lift industry, you will enjoy the Lift Industry News Knowledge Bank this edition. There are also lots more relevant papers at ***www.liftsymposium.org***

Does the design of lift equipment start with the focus on modernisation?

POINT OF VIEW

Sustainability: something we are all too aware of, but what does it mean in practice and what are the implications for the future?

I suspect these questions are exercising a lot of minds at the moment given current government targets and the drive by industry to attain them. Undoubtedly the matter has been thought about for many years and there are dramatic signs of progress, with wind farms, solar panels and electric cars perhaps the most prominent examples. Nearer to home the manufacturers and suppliers of lift equipment are actively looking at ways to reduce carbon emissions and examine the embodied carbon of products and services, while trying to arrive at meaningful ways of quantifying and measuring the impact they have on the environment and the means of sustainability.

I think most would agree that sustainability is something we really don't have a full understanding of in terms of measurement and impact assessment, and for many in the construction and service industries it is a new area where we are yet to fully develop the tools and means of defining the measurable criteria we should apply to all aspects of what we make and do.

In spite of our being at the early stages of what will undoubtedly be a long and continuous journey, we can readily grasp the concepts and start to assess the implications of what's ahead. This process leads me to questioning some of the things we do now and whether there is room to start making changes at a fundamental level to reduce material content in lift manufacture. One item that would be high on my list is the overbalance of lifts. Why are lifts balanced at 50% or thereabouts? I can perhaps understand the original thinking in terms of standardising production and seeking to maintain a maximum 50% out of balance condition, which may lead to a reduced machine size, but given the weight involved I'm not sold on the argument. We know, especially with passenger lifts, the only time they are fully loaded is when they are tested.

Look in any passenger lift and loads during heavy usage times are likely to be in the region of 50%-60% at most. Out of peak hours loading levels are reduced and an overbalance of say 40% or 45% would be much nearer to balancing the car. In some under lifted buildings these levels may be exceeded, but as demonstrated in Dr. Gina Barney's paper on car loading, the floor area has great difficulty accommodating the number of passengers detailed on the load plate. Of course there may be a need to adjust traction calculations to ensure an out of balance condition of 60% is catered for, but when looking at the potential savings in material across all of the lifts manufactured, it does point to a significant reduction of embodied carbon. I appreciate any saving will need to be measured against any increased power consumption of down travelling empty cars but the subject does start to focus the mind.

Another area of potential saving sits in the weight of bespoke car finishes. Traditionally an area driven by architectural aspiration, and designed to express the 'feel' of the building, the car interiors are generally a continuation of the main reception and lift lobbies finishes. With materials often comprising of stone, glass or timber it is not unusual in traditional lifts for a weight allowance of 1000kg to be made. The allowance is often less for machine room less (MRL) lifts but can be in the order of 500kg or more in some instances. If the levels of added weight were significantly reduced, the sheave shaft loads would be reduced and, in some instances, may lead to smaller machines and drives. Remembering each kilo saved on the car is also saved on the counterweight and you have a compelling argument with which to persuade the architect that alternative materials should be considered. In many respects it's a shame the standard finishes offered by manufacturers isn't more flexible in terms of materials offered, which in turn would hopefully provide greater levels of rigidity and robustness. The use of standard finishes would, from a sustainability standpoint, offer an easier route to verification of material sourcing and make the assessment of the product a lot easier than materials sourced from third parties; something worthy of consideration.

Power consumption is another key area of consideration and now being looked at over the lifecycle of the product. This is driven by the need to start looking at Operational Carbon (OC) together with Whole Life Carbon (WLC) whereby the product is assessed over its lifecycle rather than the separate elements of manufacture and ongoing service. In addition, for some time now we have had to satisfy building assessment criteria such as BREEAM, and while the lift element is relatively small in comparison to the whole building, it has led to a focusing on features such as regenerative drives, LED lighting and standby power reduction. A further item, discussed at the Lift Symposium, is the question of waiting times. We appear to have become locked into the 25–30 second average time but could this be extended to say 40 or 45 seconds if passengers knew how long they would be waiting? The internet of Things (IoT) has much to offer on this topic and may eventually provide accurate ETAs, however could a simple position indicator at the main lobby prove sufficient in the shorter term? Something to think about I would suggest, recognising that any adjustment in waiting time criteria would need a change to current guidance.

While I'm sure you can envisage other potential areas of saving in the shorter term, the question of long term sustainability raises a number of initial thoughts about the aims and objectives of our industry. There are two fundamental questions in my mind; firstly, should the design of equipment be driven by a minimum lifecycle of say 25-30 years? This would include MRLs, which as we know are designed as commodity products with a life expectancy of 10-15 years.

Secondly, should the original design of new equipment be driven by focusing on the long term modernisation of the product? This raises a host of questions, but with long term sustainability objectives looking at time horizons of 25 plus years and potentially the life of the building, should the focus of modernisation be concentrated on the retention of as much of the originally equipment as possible? This would include the high value capital cost items such as guides, cars and counterweights, safety gears and governors as well as machines, entrances and door drive systems. In many instances, and especially where the original installer isn't the contractor undertaking the modernisation, this would require a fundamental change of approach where the ability to 'put our stamp' on the building would be diminished and the scope or work reduced or limited. It may also lead to a position where the latest technology cannot be fully deployed, but when measured against the environmental impact of replacing major components, the sustainability argument wins out.

It should also be remembered that when undertaking modernisation works it isn't just the lift equipment that needs to be considered, a major factor is the impact of any changes on the building fabric. Replacing machines can mean changes to the original structural design to accommodate the new bedplate or raft arrangement. Similarly, fitting new entrances and landing architraves is a major building interface change which brings significant building works, all of which would form part of the project sustainability assessment.

These types of considerations will I'm sure start to shape the approach, not only to modernisation, but the design of new equipment; 'designed for modernisation' may well become the adopted pathway to a more sustainable future. The retention of as much of the original equipment as possible, combined with reducing the impact of changes to the building will become a significant factor, not only for the lift industry, but also its customers, as they also strive for sustainable solutions.

Major changes also bring the challenge of understanding new language. Environmental Product Declarations (EPDs), Design for Performance, (DfP), Product Category Rules (PCR), Functional Units (FU), Whole Life Carbon (WLC) and Operational Carbon (OC) are all terms we are going to need to become familiar with and understand as the sustainability drive moves forward. The need for assessment modeling and the associated reference points for standards and measurable criteria are all things we will need to quickly comprehend.

Much work has already been done by manufacturers and suppliers as they start to get to grips with the challenges sustainability calls for. Likewise, clients and consultants are starting to come to terms with the means of measuring the impact of sustainability as these increasingly become a fundamental cornerstone of the design process.

At this point we are still trying to assess what this all really means and attempting to come to terms with what needs to be measured, the criteria to apply and what changes need to be made. While we look to actively respond, the one thing we can be sure of is that a sustainable approach will change what we do and how we do it - significantly!

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

Call Allocation - Part 2 How Call Allocation works - theory and practice

Dr Gina Barney continues her look back through her extensive archives. In the April 2023 issue of Lift Industry News Dr Barney reviewed the results of the idea of engineer Leo Port in 1961 to put the passenger destination lift buttons on the landing, not the lift car. What Port started made huge advances with the introduction of microprocessors. In Part 2 of this series on Call Allocation, Dr Barney explains the principles the Adaptive Call Allocation algorithm published in her book, *Lift Traffic Analysis Design and Control* in 1977.

PRINCIPLES OF THE CALL ALLOCATION TRAFFIC ALGORITHM

The Call Allocation traffic controller has a number of algorithms and features. These are elaborated here.

1. Waiting time cost function
2. Journey time cost function
3. Average journey time with Maximum waiting time constraint
4. Penalty function to reduce number of stops
5. Dynamic sub-zoning
6. Adaptive control at low traffic demand
7. Look ahead factor

1. WAITING TIME COST FUNCTION

The minimisation of average waiting time implies putting passengers into the first lift that arrives. This would result in no change from the usual procedure and would be used for light traffic conditions.

2. JOURNEY TIME COST FUNCTION

During an uppeak, the obvious cost function to implement with Call Allocation is journey time. This is because a waiting time allocation criterion would do no more than allocate every new call to the first available lift at the main terminal which possessed space capacity, in the same way as the collective-distributive algorithm. If journey time is the cost function, calls terminating at the same floor tend to be allocated to the same lift, hence reducing the number of stops per trip and the round trip time. The system handling capacity is increased and the main terminal floor more frequently served. However, a waiting passenger may not be allocated to board the first available lift, and this may produce increased waiting times. The overall effect is that better journey times are produced, in comparison to conventional algorithms, for the whole range of traffic intensities, but can result in longer waiting times. Thus some passenger waiting time is sacrificed to provide shorter passenger average journey times. The maths is as follows.

Consider that a new call is to be allocated to a system of L lifts, each lift (l) with $N(l)$ calls to answer and $JT(l)$ accumulated journey time for the $N(l)$ calls.

Assume that *NJT(K)* is the new accumulated journey time for *N(K) + 1* calls, when the new call is allocated to lift *K*. The average journey time for the complete set of calls is:

$$AJT = \frac{NJT(K) + \sum_{l=1, l \neq K}^{L} JT(l)}{1 + \sum_{l=1}^{L} N(l)} \qquad (1)$$

This can be written as:

$$AJT = \frac{NJT(K) - JT(K)}{1 + \sum_{l=1}^{L} N(l)} + \frac{\sum_{l=1}^{L} JT(l)}{1 + \sum_{l=1}^{L} N(l)} \qquad (2)$$

As the two summations in Equation (2) do not depend on the allocation *K*, the minimisation of *AWT* only requires the minimisation of the term *NJT(K) - JT(K)*. This simplifies the evaluation of the cost function, as only this incremental cost is to be evaluated instead of the whole expression for *AWT*. The quantities *NJT(K)* and *JT(K)* are evaluated by simulation.

It should be noted that the incremental cost *NJT(K) – JT(K)* is made up of several terms. It includes the waiting and journey times for the new call and the increase in the waiting and journey times of calls already allocated to lift K, the extra passenger transfer time resulting from the new call, and any extra stops to pick up and discharge the new passenger.

3. AVERAGE JOURNEY TIME WITH MAXIMUM WAITING TIME CONSTRAINT

A third type of cost function, proposed by Closs (1970), uses average journey time with a maximum waiting time constraint. It operates by costing each allocation against an average journey time cost function, but penalising any solution for which the waiting time of the new call exceeds a predefined value of maximum wait *(MWT)*. The Adaptive Call Allocation algorithm operates as follows:

(1) Evaluate cost of allocation of the new landing (hall) call to lift 1:

$$COST(1) = NJT(1) - JT(1) \qquad (3)$$

(2) Compare the new call waiting time *NCWT(1)* with the predefined value *MWT*. If it is smaller than *MWT*, then *COST(1)* is not altered, but if it is greater a penalty is added to the cost:

$$COST(1) = COST(1) + penalty \qquad (4)$$

The penalty is made up of a fixed value added to a term proportional to the excess of waiting time above *MWT*. For example:

$$penalty = 300 + 10\,(NCWT(1) - MWT) \qquad (5)$$

(3) Repeat the procedure from (1) for all lifts.

The effect of using a penalty is to force the elimination of the allocation to lifts with an existing high number of allocations from receiving another allocation, making it easier to select a more lightly loaded lift.

4. PENALTY FUNCTION TO REDUCE NUMBER OF STOPS

The "positive" concept of using a cost function as a performance index can be transposed into a "negative" concept of penalty functions in order to promote higher efficiency. An example of a penalty function is the rejection of an allocation which introduces an additional stop.

The Call Allocation algorithm causes calls requesting the same destination floors to be carried by the same lift. This has the effect of reducing the number of stops. However, in some cases the cost of allocating a new landing (hall) call to a lift already stopping at the calling landing (hall) or destination floor is marginally greater than the cost to allocate the call to another lift not stopping at either floor. Although the allocation is perfectly proper, it might be better not to allocate the new call to the lift with the lowest cost, as by not doing so capacity is reserved for future calls. To cater for this idea a penalty *p*% is introduced for each extra stop motivated by the new call. To prevent operation of this penalty under low traffic conditions, the penalty is made dependent on the incremental cost of the allocation and is proportional to car load.

$$\text{penalty} = \frac{p}{100} \times \text{incremental cost} \times \frac{load}{AC} \qquad (6)$$

where, *AC* is the actual car capacity and the load is measured as the average value of the number of passengers inside the lift, or queuing for service. The procedure improves performance for values of *p* up to 10%. For larger values of *p* the algorithm is self-defeating, as it produces less appropriate allocations.

5. DYNAMIC SUB-ZONING

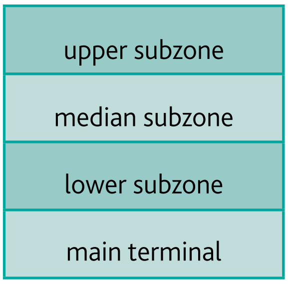


Figure 1 Example of subzoning

Uppeak sub-zoning is sometimes used by conventional group control systems to improve the uppeak handling capacity. Sub-zoning is very sensitive to where the zone partition is fixed and should ideally be adjusted for every traffic situation. As in practice a fixed partition is implemented, it cannot respond to the wide fluctuations found in arrival traffic patterns. Knowing the advantages of uppeak sub-zoning, and the adaptability of a computer implemented algorithm in coping with input traffic variations, a dynamic subzoning concept can be implemented in the Call Allocation system. The main features of this technique are:

- The building is divided into three subzones, as shown in the **Figure 1**.
- The lifts are divided into two subgroups, one for the lower sector and the other for the upper sector.
- No indication of this partition is given to the passengers.

A newly registered landing call is allocated to a lift in the usual way, by evaluating the costs of the allocation of the call to every lift and choosing the allocation giving the lowest cost. However, during the evaluation of the cost, the allocation of a call registered for the lower subzone to a lift allocated to the upper subzone is penalised, and so is the allocation of a call with a destination in the upper subzone to a lift in the subgroup serving the lower subzone. The penalty, which is added to the cost of the allocation, is a function of the load of the two subgroups of lifts, and can be expressed as:

$$\text{penalty} = \left(1 + \frac{b}{100}\right)M \qquad (7)$$

where, *M* is a constant value and b measures the imbalance of lift loads between the upper and lower subgroups as a percentage of the equation highest subgroup lift load.

The fact that the loads of the two subgroups of lifts are taken into account contributes to equalise these loads. For example, the allocation of a call terminating at a floor in the lower subzone to a lift assigned to the upper subzone can be penalised by a quantity ranging from zero, if all the upper subzone lifts are idle, to 2*M*, if the lower subzone lifts are idle.

A call registered to the median subzone can be allocated to either subgroup of lifts, with preference for the subgroup with the smallest load. The allocations to the lifts assigned to the heavier loaded sub-group are penalised by a quantity which equals the absolute value of *b* multiplied by *M*.

A correction mechanism allows this technique to deal with extremely unbalanced traffic destinations, as if excessive unbalance between the subgroup loads is detected, the subzone limits are automatically adjusted.

6. ADAPTIVE CONTROL AT LOW TRAFFIC DEMAND

Algorithm switching was difficult with relay based systems and often resulted in the wrong algorithm operating. Whilst passenger demand is high then the full power of call allocation can be realised. However at light loads, say less than 60% occupancy, there is little point in collecting passenger travelling to the same floors together. Thus at light loads passengers should use the first car to arrive. The Call Allocation algorithm knows which lift this will be and can direct the passenger to it. The control system can detect the increase in passenger demand and switch from a waiting time cost function to a journey time cost function.

7. LOOK AHEAD FACTOR (*K*)

Equation 1 includes a factor *K*. this represents the lift being considered for a call allocation. This means that *K* can have a value up to the number of lifts in a group. It cannot be larger as it would mean a new group of passengers would waiting for the first batch to be transported before their turn came.

In practice *K* should be no larger than three. If *K* is any larger than then passengers will have to wait for the fourth or five car to arrive, etc. before being transported.

Call Allocation is most effective when applied to large groups of at least four cars. It can be applied to three car groups in certain circumstances, but then *K* should be no larger than two.

It is very ineffective where a group contains two lifts then the maximum value for *K* can only be 2. It might then be used as a way finding mechanism, where a duplex is installed and the lifts are not adjacent or across a lobby.

The main effect of landing call allocations three cars ahead is that once announced to the passenger they cannot be changed. Circumstances such as delays in boarding, holding doors open, etc. can make the allocation not the optimal one. A conventional system can change its allocations with changing conditions.

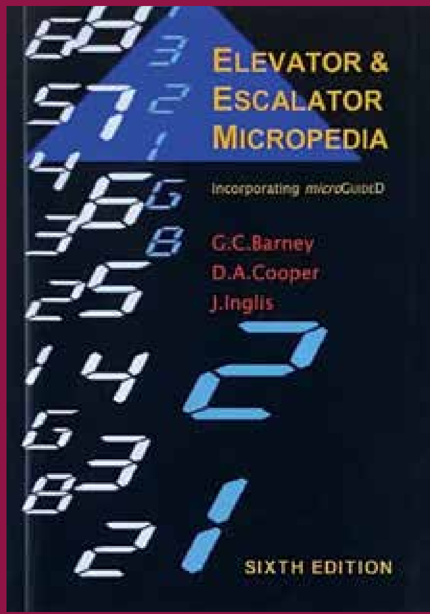
Dr Barney is of the opinion the modern "Destination Control" systems do not include many of the features offered by Adaptive Call Allocation, and that designers of traffic control systems would be well advised to study and implement ACA as described in this article.

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.

ELEVATOR & ESCALATOR MICROPEDIA



The Elevator & Escalator Micropedia is a compendium of useful data providing a handy first "port of call" for information. It comprises: a glossary of over 2150 terms; drawings of lift components; tables & formulae and a "microGuideD" referencing CIBSE Guide D 'Transportation systems in buildings'.

The book has been complied by industry experts from authoritative sources across the world. It will be of practical use to designers, field service personnel, installers and engineer surveyors.

Also, building owners, facilities managers, lift operators, teachers, researchers, students, etc. will find it a helpful reference book.

This edition has been extensively revised to cover the advent of EN 81- 20 / 50 and the emergence of the ISO 8100 family of standards.

Copies of the Elevator & Escalator Micropedia can be obtained from

https://www.cibse.org/knowledge-research/knowledge-portal/geem-elevator-escalator-micropedia-6th-edition-soft-cover

Price £12.50, {£11.00 CIBSE Members} (no VAT)

For quantities over 10 units:-

CONTACT »
Dr Barney
(015396 20790)
Knott House,
Sedbergh, LA10 5LU

BEHIND THE SCENES AT LEIA

NEW OFFICES

At the start of April, LEIA HQ moved from Devonshire Street to Rotherwick House, London E1W; home to trade associations such as ECA, BEAMA, BESA, GAMBICA, EDA. Our telephone numbers will remain the same.

Uptake in distance learning from apprentices

Dan Charlesworth, Training and Development Manager

We have seen an uptake in the number of apprentices embarking on our introductory distance learning modules this year. This is particularly good news when considered against the backdrop of decreasing apprenticeship take-up nationally.

The introductory module is the perfect starting point for apprentices looking to start their careers. It provides an overview of the industry, including its history and important systems and tech. It is an excellent way for new apprentices to familiarise themselves with the industry's vocabulary and concepts, and to gain an understanding of the work they will be doing.

Distance learning FAQs

Distance learning study routes

- Most students start with the Introduction to Lift Technology followed by Fundamentals of Lift Technology.
- Students working only on escalators or passenger conveyors usually go straight to the escalator and passenger conveyor unit.
- Those who have completed the Introduction to Lift Technology followed by Fundamentals of Lift Technology will often go on to the advanced units.
- Those involved with contractual issues and/or site work may choose to undertake the Practical Management of a Lift/Escalator Contract Part 1 Commercial, Practical Management of a Lift/Escalator Contract Part 2 Site or IOSH Managing Safely for LEIA.

When do courses start?

There are three starts within the year; 2nd January, 1st May and 1st September. Any unit can be started at these times (Half and Full). Units must be completed in a set time (see Study Timetables below).

What are the technical requirements?

The candidate MUST have an accessible e-mail address – where possible, all communication will be via this means. You will need a computer with Adobe Reader v9 or higher. Internet access is needed when undertaking the Computer Marked Assignments.

Find out more about distance learning at ***www.leia.co.uk***

The first LEIA Quality and Technical Committee (QTC) meeting at our new HQ

5 MINS WITH KAREN SLADE, HEAD OF LEIA END POINT ASSESSMENT

Two years on from the launch of LEIA End Point Assessment we catch up with Head of EPA, Karen Slade.

My journey into the world of apprenticeships began in 2019 when I trained as an assessor for a large hospitality training provider. Since then, I've worked with a local government membership organisation and for a sector specialist awarding organisation. I'm qualified in assessment, internal quality assurance and certified by the CIPD in Learning and Development practices.

I was employed in another role when this job was thrust into my lap, by an FE specialist recruiter who said, *'Karen, this is your job, this is the one we have been waiting for'*. I was attracted by the challenge this role posed and the opportunity to create something pretty much from scratch for a sector that had never been exposed to end-point assessment before. Luckily, Nick Mellor saw that I would be a good fit for the organisation and felt I was up to the challenge!

I have been fortunate enough to work across a few sectors and the thing that strikes me the most about the lift and escalator sector is the commitment of employers and their desire to be involved in shaping their apprentices' training. This sector really does capture the spirit of employer led apprenticeships.

What does your role at LEIA involve?

I have an incredibly varied role which currently includes everything from customer engagement / support through to compliance management as the Responsible Officer reporting to Ofqual, the qualifications regulator in England.

LEIA is recognised by Ofqual which was my first (and biggest) project. We have a team of eight associates who work with us on assessment, quality assurance and assessment design, who have been trained from scratch in how to offer the service we provide. We offer three apprenticeship standards, all in different stages of delivery. We have been actively delivering end-point assessments since August 2022.

What's the relationship between an EPAO and the employer?

My top priority will always be providing excellent customer service to employers and apprentices and delivering a robust and credible end-point assessment. Those principles run through the core of everything we all do here. The employer is our customer and as such we are there to provide a service, but I am always on hand to provide advice on other areas relating to apprenticeships where I can. My assessment team conduct most of the interaction with their apprentices and every single one that comes through our service is important and an individual to us.

Can you explain the EPA / apprenticeship process?

Apprentices who complete an Apprenticeship Standard are trained by a training provider and their employer who determine the training content for each apprentice. Their training needs to support the apprentice in gaining competencies against a range of defined knowledge, skills and behaviours. When the apprentice has completed their training and their employer believes they are ready, they come forward for end-point assessment (EPA). EPAs are delivered by independent organisations who have not had any involvement with the apprentice's training. The purpose of end-point assessments is to provide an independent unbiased view of someone's competency based solely on the evidence provided during the assessment process. This type of assessment is on par with those of GSCEs, BTECs or A-Levels.

And finally, tell us what you like to do in your spare time

Anyone who knows me will know I am a 'crazy animal lady'! I own two horses, two dogs and two cats. At the same time as I started working for LEIA, I embarked on my functional fitness journey which has been one of the biggest character-building experiences of my life. These all keep me busy alongside family life and a busy career.

www.leia-assessment.co.uk

SAFETY FIRST

DON'T GET TOO CLOSE

This edition's column is about the risk of entrapment between the building fabric and an escalator handrail and follows on from the April 23 column where I looked at the passenger contribution to escalator accidents.

I make no apologies for referencing my old chum Dr Lutfi Al Sharif again and repeating the use of his Venn diagram from his paper entitled "Escalator Human Factors: Passenger behavior, accidents & design" [1]. You will recall that he identified three inputs to escalator passenger accidents.

These were:

- Design
- Maintenance, Inspection & Operation
- Passenger Behaviour

The Venn diagram can be seen below (Fig 1).

I made the point in the last edition that the number of escalator accidents involving personal injury occurring are rising and litigation following accidents is similarly increasing. Sometimes you have to be careful what you ask for and following the last edition I received a number of messages and photographs about passenger contribution to accidents. I thought I would share a couple of height problem photographs with you as they amused me, although the potential outcome could have been far worse.

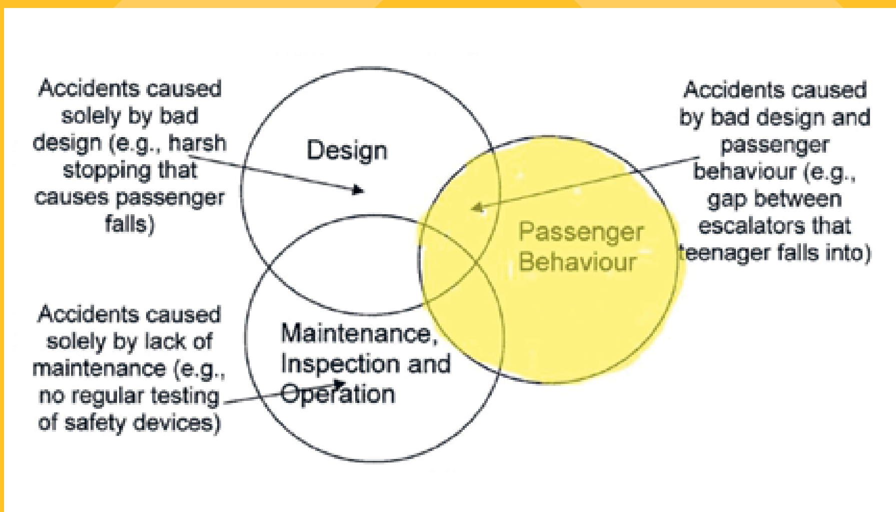


Fig 1: Al Sharif Venn Diagram [1]

The photograph 1 shows some sports equipment taken onto an up running escalator. The damage to the step band is immediately obvious.

Photograph 1.

Photograph 2 shows a similar issue but on a down running escalator where a passenger taking a 12ft ladder down nearly ended up with two 6ft ladders:

Photograph 2.

I want to concentrate on the design element of the Venn diagram. Incidentally I would like to see some research in this area splitting design into the escalator itself and its environment. You can manufacture a perfectly good escalator complying with EN115 but when you install it there may be hazards and risks that are introduced.

BS5656 part 2 covers risk assessment based on the environment in which an escalator is installed.

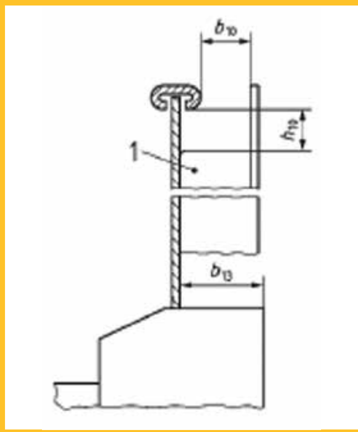


Fig 2.

On that note I want to look at dimension b10 in EN115-1 (2017) as pictured above in fig 2.

In simple terms there should be a clear space of at least 80 mm from the edge of the handrail to a part of the building fabric.

This is to minimise the risk of entrapment by body parts of passengers such as hands etc.

I can hear you asking yourself "does that really happen?" and I am afraid that it does! (see fig 3 below)

Child trapped in escalator saved by kiss-of-life

A THREE-year-old girl who stopped breathing after she became trapped in a department store escalator was revived yesterday with the kiss-of-life by a firefighter.

The child turned blue after becoming caught in the moving walkway at H&M in Ayr, Scotland, in the "freak accident" yesterday.

Fire crews arrived at the shop on Kyle Street three minutes after being called at 12.10pm and rushed to the first floor where the girl was trapped.

Horrified shoppers activated the stop button when the youngster screamed for help as she was dragged upwards by the escalator.

Her body became squashed between its glass panel and an aluminium side panel as she was pulled along by the rubber handrail, said firefighters.

A quick-thinking shopper smashed the glass panel, providing immediate relief to the youngster but she had already turned blue and stopped breathing.

One of the firefighters placed the girl on her back and revived her with mouth-to-mouth resuscitation.

Strathclyde Fire & Rescue's Craig Shaw said: "I've been to incidents before where people have got fingers caught in escalators or are trapped in lifts.

"But this was quite different as it was the child's whole body which got trapped in this walkway, it was a real freak accident. The poor thing got a real fright."

The girl was taken to Ayr Hospital where her condition was not thought to be serious, said Strathclyde Police.

Fig 3.

The escalator industry and owners have been moving towards preventing people accessing the step band with shopping trolleys and luggage carts (research document available if any reader would like a copy) which is commendable but such retro fits need to be undertaken taking into consideration other hazards and risks that may be introduced that could cause injury.

On that note, and whilst out and about in the past few weeks, I have been collecting photographs of classic mistakes in this area which I share with you below and on page 27.

Photograph 3. Too close!

Photograph 4. Too close!

Photograph 5. Too close!

The problem is that many escalator owners simply install these devices without talking to the escalator manufacturer, maintainer and/or a specialist consultant and after they are fitted the owner is reluctant to amend their well intended addition and therefore run the risk of entrapment.

As always please send me your photographs and experiences.

REFERENCES

[1] Al-Sharif, "Escalator Human Factors: Passenger behavior, accidents & design", DNK

BIOGRAPHY

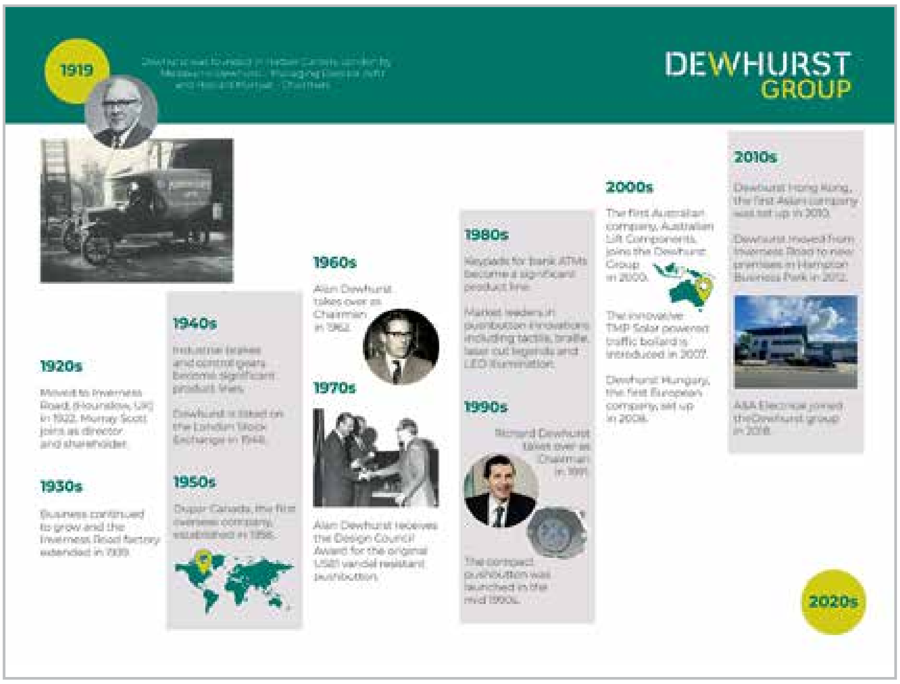
EurIng Prof. David Cooper BSc (Hons), MSc, MPhil, CEng, FIET, FCIBSE, FSOE, FCGI,

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.

In June 2023 Dave was awarded an MBE for services to (lift & escalator) engineering in the King's Birthday Honours list 2023.

THE INTERVIEW

Based on four continents, Dewhurst Group is a global supplier of quality components to the lift, transport and keypad industries. The company was founded in 1919, but in the last 30 years the Dewhurst Group has grown from a business in Hounslow with one Canadian subsidiary to a group of businesses stretched across the world. We caught up with Chief Executive Officer, John Bailey, to find out more about the group and their vision.



Could you explain the extent of Dewhurst Group's offering – what do you do?

We've been around for over 100 years and even though we're now listed on the Alternative Investment Market (AIM), Dewhurst is still majority family owned. We operate across four continents with 11 companies, giving us a diverse spread, geographically, as well as the actual products we supply.

We started in the lift industry and then developed into transport and keypad industries, supplying components for a wide range of uses. We're in the business of transporting people, usually vertically, so transport was an obvious industry to move into, and similarly with keypads, it was a transferable service. We innovated a more robust metal keypad for cash machines to replace the rubber components that were being vandalised.

Your People Strategy is centred on honesty and integrity, how do you empower your colleagues?

People are our biggest asset. My favourite saying is "Value people, not position", and that's so important to me. It doesn't matter if you're the cleaner, the driver, the procurement manager, whoever you are, you're an integral part of our team. There is so much value in everyone we have here.

We are a diverse and inclusive organisation, and people are a key part of running our group. It's essential that we all have clearly defined roles, but that we have also maintain open lines of communication – both locally and globally. I send out a regular bulletin to staff, which I started before I became CEO, to ensure that whoever they are, and whatever their role, all staff had access to a communication from me. It gave them a flavour of what to expect from me, what I wanted from them, and to highlight key milestones and global issues. I now receive emails back from staff who have read it and want to engage with me personally, which I really enjoy.

When I travel to any of our businesses, I make sure my first action is walking the floor of the factory and meeting people; it's so important to me that I get to know our teams, what they do and their key issues, concerns and ideas. If you don't do that, you won't hear what's really going on. I want to continue to make it easier for our staff to engage with us, so they feel more empowered in their roles.

We have champions in each business that work on global initiatives around ESG, health and safety and marketing, and I am already seeing some great ideas being shared. We've got passionate, likeminded people working on key projects which is so important to me. Already I've seen ideas around hazard identification and reporting standardisation, recycling of waste materials in-house, the application of reflective window films to deflect heat and installation of solar panels as well as more activity and engagement on social media, particularly LinkedIn. I really enjoy seeing what our people are doing and what they're sharing and I want to modernise our approach to how we engage. We've all got a job to do, but that doesn't mean we can't have fun along the way.

With businesses and colleagues across the world, how important is it for you to maintain a sense of consistency across each business? Or is each company very different?

Each of our businesses is managed locally, with the strategic direction devised communicated, managed and delivered locally, but they are all supported by Dewhurst Group functions of finance, HR, Marketing, IT, and Environment, Social and Governance (ESG).

The businesses are diverse in so many ways, not just geographic location! There are some operational similarities, but they operate in very different markets. Although they run autonomously, it's important that each business feels that it's part of our group. We maintain consistency firstly in our financial and statutory governance, but most importantly through our values and culture which run throughout our businesses, worldwide.

These values are:

- Integrity
- Quality
- Curiosity
- Progression
- Sustainability

We promote and live these values throughout every business, and this ensures our people around the world feel the benefits of being part of a global group. We have people that move across businesses around the world, and they'll recognise the same culture wherever they go. One of our engineer's sons has come to England from Canada to do an internship in Marketing. I absolutely recognise that I'm looking after his prized asset, so made sure they came to see me when they made the journey over. It's so important to me to have that sense of care for every member of our team.

What are your personal priorities for the company over the next year?

Simply, I want the group to grow and ensure our people are at the very heart of the business. We're working on a number of things to develop our people.

Can you tell me about Dewhurst's vision and how you ensure it runs through every company in the Group?

Our vision is to shape the future of our industries and make a meaningful contribution to a more connected and sustainable world.

We want to make sure we enhance the way people live, work and move - across our customer base, but also our own people. Our products allow that, but we also want to ensure that we remain a diverse, inclusive global group. If we continue to grow, that will provide more opportunities for our people on a global level.

We've developed individual business plans, aligned to our group strategy, but it is the engagement of our people that will help ensure we achieve our objectives. It's how we take them on that journey of growth, modernisation and focus that's crucial. We're living in a changing world, and communication and engagement is key. It's all about the people.

Is there anything you do as a company that you consider sets you apart?

We've got a lot that sets us apart from others. Our long history, our people, but also our pioneering spirit and innovation, and I want that to continue. We've worked really hard, specifically within our distribution businesses, focusing on processes and technology including scanning and e-commerce which is scalable and will deliver both operational efficiency as well as customer satisfaction. Using technology to communicate with our customers, for example, to let them know where deliveries are, taking control of our vehicle fleets, we have so many initiatives that we're developing to enhance our services.

We have a clear focus on ESG in all our businesses and are committed to reducing our carbon footprint, in our business and our products. We have champions and an ESG programme manager in the group.

Our transport business, TMP, make bio bollards – Manchester BIO and NonCrete Bollard – from a bio polymer derived from sugar cane. At Dewhurst we have developed a more resilient pushbutton to withstand harsher cleaning conditions.

It's important, for me, that we extend the environmental initiatives that we've been working on for a long time to be included in our products, wherever possible. New technologies and new materials that are more sustainable are key and I'm seeing some great innovation.

What's next for Dewhurst?

Our aim is to grow, and we have some very exciting things planned. My responsibility is to look to the future – I'm planning for the next hundred years. Suffice it to say, we haven't come this far just to come this far!

To find out more about the company, visit their website - ***https://www.dewhurst.co.uk/***

DEWHURST GROUP

Our values

- Integrity
- Quality
- Sustainability
- Progression
- Curiosity

+44 (0)20 8744 8200 cosec@dewhurst-group.com www.dewhurst-group.com

A UNIQUE PART OF INDUSTRY HISTORY
THE ELEVATOR MUSEUM

From left to right Steve Comley, Patrick Carr and Steve's father Jim and the meet and greet guy, Boomer the dog.

The origin of the museum

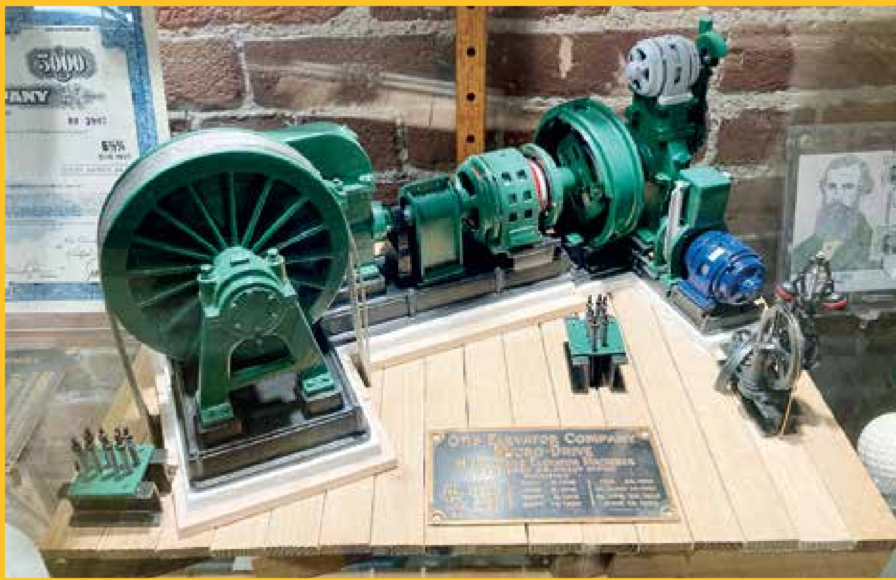
Patrick Carr started the Elevator Historical Society and Elevator Museum in New York in 2011. Steve Comley, a lifelong part of the elevator industry, was a Director of the Elevator Historical Society with Patrick from 2013 -2016. Sadly Patrick closed the museum due to lack of support and funding.

Steve asked to have all his family's artifacts back and during the summer of 2017 he made several trips back and forth to New York, bringing artifacts back to the meeting room of Boston IUEC (International Union of Elevator Constructors) Local#4 - who have been part of IUEC since February 1899!

Steve purchased display cases and put the items on show in Boston. Throughout the next two years he acquired many more items from IUEC members from around the country, Boston Local#4 members and Patrick.

In 2018 Steve was asked to get the artifacts out of the meeting room because the collection was getting too big. It has never been a museum open to the public, so Steve and his supporters knew they had to leave if they were to ever get outside support.

Friends, visitors and a bus load of IUEC elevator guys from New York.



In the summer of 2018, Steve started the "Elevator Historical Society Committee" through which they hired the Foundation Group that established "The Elevator Museum Inc." a Non-profit 501(c)(3) Organization in 2019.

The fledgling museum moved out of the Union Hall and into a building in Haverhill, Massachusetts in 2019 and then to their new location 77 Elm Street in Amesbury, Mass. in 2022.

A love for elevators

Steve says:
One of my first jobs was working for my father's elevator company. He owned Embree and White Inc. Millwrights / Elevators, est. 1873. At 14 years old, on weekends I went with him to clean the shop. The shop bays were full of old elevator machines and parts. I would smash the old drum machines up with a sledgehammer, put the pieces into a pick-up truck and get bring them to the scrap yard. I got the money for the scrap but always asked why we were destroying all these incredible machines that so few people had ever seen before. My father's answer was, "they are not going to ever run again, they are no longer legal to install and too big and heavy to keep around." I was never happy with this. I had personally destroyed many old elevator machines, something I'm trying to save today. Ironic twist in life!

I worked in the elevator industry for over forty-three years and held 4 different licenses, QEI, NH State Elevator Inspector, Mass. & NH Elevator Mechanic and IUEC Boston Local#4 Member. I retired at the end of March this year but still work part-time at The Elevator Museum with the hopes of keeping it open.

I collected every old elevator artifact I could throughout my career in hopes of building a museum someday. The Elevator Museum has been a labor of love for many years, and it has to survive. I worked there almost every day for many years trying to get everything out and displayed properly.

It's been a struggle financially because we don't make enough money from our visitors but it's absolutely imperative that we preserve these incredibly rare artifacts as a collection for all to see. The people who visit are fascinated with the presentation we have so I know we are headed in the right direction.

Can you help support this unique museum?

https://theelevatormuseuminc.org/

NEWS FROM THE CIBSE LIFTS GROUP

CIBSE Lifts Group

CIBSE Lifts Group Manchester Seminar 6 June 2023

Following the success of the June 2022 Seminar, the CIBSE Lifts Group welcomed an even larger crowd this year at the Manchester Chamber of Commerce to discuss the relevant theme of "Accessibility".

BS EN 81 70 recommends the minimum requirements for the safe, independent access and use of lifts by persons, including persons with disabilities.

Adam Scott, Technical Director (Vertical Transportation) at Sweco UK, and BSI codes and standards representative for the CIBSE Lifts Group, reviewer of BS EN 81-70:2021 + A1 2022, presented "Our Accessible World and the New Part 70", covering the amendments in the A1 2022 revision.

You can access his presentation here:

https://bit.ly/438w2NT

Phil Pearson, director of Pearson Consult and vice-chair of CIBSE Lifts Group, presented "BS8300 Design of accessible and inclusive built environment", providing an overview of the revised standard.

BS 8300 is important because it is the only British Standard to cover all aspects of accessible and inclusive built environment design. Phil talked about the differences between BS 8300 and BS EN 81-70 and the implications for the lift and escalator industry.

His presentation is here:

https://bit.ly/3NPKaal

FOLLOW us on in

Keep up to date on our web site

A LIFE IN THE DAY

Angela Mace has worked at TVC since she was 16. Having spent the whole of her career in the lift industry, she is now Customer Service Manager at lift control and monitoring specialists, TVC. We spoke with Angela about her time with TVC and just how important having a good team is...

Talking team work with Angela Mace

ANGELA TOLD US A LITTLE BIT ABOUT HER JOURNEY THROUGH TVC AND HOW EVERY DAY IS DIFFERENT.

"I started working on reception at the age of 16, and was quickly moved over to a role in customer services. As the company has evolved and the customer base has expanded, so has the job, and the team has grown around us. Now 26 years later, I'm Customer Services Manager.

"There isn't a typical day here at TVC, every day is different, with its own challenges! I have a lot of virtual meetings with customers – that's our main focus, keeping in touch with them. I started this role just before Covid hit, so we couldn't go out and visit customers, but now we're meeting more of our customers face to face, so I travel to meet them, engaging with them and ensuring we're visible, whether that's in person or virtually. I have 12 team members, and we work together to offer the best service to our customers."

HAVING SPENT HER WHOLE CAREER AT THE COMPANY, ANGELA'S PASSIONATE ABOUT ENSURING TVC'S CUSTOMERS RECEIVE THE BEST SERVICE WITH THE HIGHEST QUALITY PRODUCTS.

"TVC is best known for our quality products, primarily Ethos Two lift control panel, Ethos Navigator Destination Control and our CMS Anywhere monitoring products. We have lots of other products such as CCTV, Mercury screens, lift autodiallers, GSM and SIM products. 2023 is an exciting year for us here at TVC as we have released new monitoring products, which will monitor a broad range of assets.

"Our motto is 'We never walk away'. In simple terms, that means that we are always there to support all our customers. From a general enquiry to telephone or on-site support, providing next day delivery on most parts, offering modifications and repairs to lift control panels, we support all our customers in the way they need us."

CUSTOMER SERVICE IS, OF COURSE, AT THE HEART OF ANGELA'S ROLE, AND SHE EXPLAINED THE VISION FOR TVC OVER THE COMING MONTHS.

"Our vision is to continue to be the best in class and grow our customer base, including lift companies, local authorities, housing associations, hospitals and more.

"We're further developing our Ethos 2 control panel, which now features pre-wired connectivity solutions to reduce site time and cost. We also continue to develop our monitoring products to incorporate predictive and preventative maintenance.

"We're always striving to improve our internal processes; making life easier for our wonderful colleagues, which means that we can better serve our customers.

"Our new Virtual Link is also launching – where a remote expert can see a real-time view of any issues an onsite engineer is having. This will reduce time on site and improve the customer experience, rectifying issues more quickly and avoiding extra call-outs. We are also introducing an FAQs section on our website for customers to find additional support with frequently asked questions alongside user videos to help in setting up and fault finding."

WITH A TEAM-FOCUSED ETHOS, ANGELA EXPLAINED HOW IMPORTANT IT IS TO NURTURE THOSE CONNECTIONS, INSIDE AND OUTSIDE OF WORK.

"Our ethos is to support each other and also to enjoy what we do. We encourage everyone to get involved in activities in and out of work, whether that's charity events or socialising with a meal at a local restaurant. We have a wall of fame in our offices which displays all our fun get-togethers, whether work events or socials. I really couldn't do my job without the support of my team. It really is like a family; people are very close."

RECOGNISING THE IMPORTANCE OF GETTING THE RIGHT WORK/ LIFE BALANCE, ANGELA TOLD US A BIT ABOUT HOW SHE MANAGES THE JUGGLE.

"You'll either find me in my garden, walking my black Labrador, George, or doing Pilates. I love my job and I love my family, it's important to get the balance right in both. Thinking of new ways to improve our customers' experience with TVC really excites me, and having the best team around me really helps. I'm constantly learning new things, and I enjoy that. But I also love my family time, taking day trips and holidays, which is so important too."

SUMMING UP HER ROLE AT TVC, ANGELA TOLD US HOW MUCH SHE VALUES HER TEAM IN DRIVING THE BUSINESS FORWARD.

"Our wider TVC team, from Engineering to Production, it is really just like a family, and we are all passionate about continuing to improve our customers' experience with us, and using the latest technologies and innovation to help do this. We want to continue to improve response times, reduce the need for engineer site visits by using new products and approaches, and continue to make resources easily accessible to our customers. We can only do this through our close teamwork, supporting each other and sharing the same vision."

To find out more about any of TVC's solutions, visit https://www.tvcl.co.uk or contact us for more information on 01352 793222.

RECLAIMING ELEVATOR POWER

How line regeneration can improve energy efficiency in elevator applications

The UK Government set an objective to halve the energy use of new buildings by 2030. It's widely accepted in the industry that elevators represent between three to seven per cent of a building's energy consumption, so the use of regeneration to improve the energy efficiency of elevators and escalators can play a part in achieving these targets. Here Brian Preston, general manager at elevator drive specialist CP Automation explores how regenerative braking systems can improve lift efficiency and help building owners enjoy significant benefits.

In most lifts, the counterweight is sized such that if a half load is placed in the cabin, and the mechanical brake is lifted, the lift doesn't move. The counterweight is heavier than the cabin so, for example, with an empty lift cabin travelling up, the motor would overhaul and push energy backwards. Similarly, if the cabin is at full load and travelling downwards, it will be heavier than the counterweight — again, overhauling the motor.

ENERGY MANAGEMENT

When the motor overhauls, it requires negative torque and creates energy that would historically have been exported to resistors and lost as heat. Then, not only is the energy lost as heat, but further energy is required from building systems such as HVAC to manage the heat and keep the equipment cool. In elevator applications, this process occurs to a smaller or greater extent on every run and this energy must be properly managed to prevent drive faults and other equipment damage.

Building Research Establishment Environmental Assessment Method (BREEAM) is just one example of an assessment method that is used to determine the levels of sustainability of a building. Buildings that receive a high BREEAM rating will often benefit from lower running costs because they're naturally more energy efficient. Also, the higher rating has the added benefit of creating a more pleasant working environment, so businesses are not only more likely to pay higher rates but also occupy those buildings for longer.

Efficient elevators with speeds >0.15m/s can contribute up to three BREEAM points by meeting the criteria published in the Energy section of the BREEAM assessment and, specifically, Ene 06. The use of regeneration on those elevators alone can contribute one of those points.

LINE REGENERATION

We can't turn the meter backwards, but we can slow the meter down and harness the excess energy, rather than seeing it go to waste. Regenerative braking systems like RegenAC reclaim the energy generated from the overhauling motor and supply it back to the three-phase AC power system so it can be used elsewhere in the building. This includes powering PCs, air conditioning or other electrical systems on site that draw their power from the wider energy network.

By working with an expert that understands how the whole lift system works, building owners can understand the cost benefits of different technologies and how they can help them achieve efficiency accreditations.

For advice on how you can improve the return on investment of your elevator, visit ***https://www.cpaltd.net/industries/elevator/***

BRIAN PRESTON

Brian Preston joined CP Automation as part of the company's acquisition of the Magnetek business in 2020 and his role involves managing the day-to-day running of the office while managing product lines, generating new business and providing technical support. Since his early career with Omron, then Magnetek and now CPA, Brian has been dedicated to the supply and support of AC and DC drives to the lift industry.

Can we help...

Are you employed in the Lift industry?

Have you, or someone you know, had a works related accident?

Did you know there is financial help available?

LIFT INDUSTRY CHARITY

The UK Lift Industry Charity

Run by Lift People for Lift People

The UK Lift Industry Charity Mission... The relief of financial hardship and provision of appropriate support where required to industry colleagues and their families who have been injured whilst working or employed within the industry.

The Charity has made numerous donations to individuals and the families of individuals who have been injured or sadly killed, whilst working in the Industry. We are continually looking for opportunities where we can assist.

Can we help you, can you help us, would you like to join in the next **2023 Cycling Challenge** just email

reiss.stygal@aa-electrical.com
www.liftindustrycharity.co.uk

Thank you to all The Lift Industry Karting Challenge sponsors, donors & participants

Charity Registration No. 1119434

HERE WE GO, HERE WE GO

20 football teams made up of 150 people from the lift industry and 23 different lift companies entered the first ever Lift Industry Mental Health Charity Football Cup.

Taking place during mental health week on the 20th May 2023, it was all about raising awareness around mental health along with raising money. The event has raised over £6000 already but with donations still coming in the charity hopes to get to £8000, all supporting mental health courses within our industry.

The format was a mini league across four 5 per side pitches, each game lasting 14 minutes. There were over 200 goals, averaging 5.5 goals per game so a lot of action for the supporting friends and families to see. The Golden Boot went to Jack Kleen from Temple Lifts who scored a fabulous 12 goals!

The winners of league A and B then created an 11 per side team, who played the team created by league winners C and D, for the main trophy within the Dartford Football Club stadium.

A number of companies had a large number of very keen footballers amongst their employees and ended up entering 2 teams in the 5 a-side tournament: CTA, Fujitec, Jackson, Mitsubishi, MKM Lifts & Target Lifts.

Add to that Centro, BR Lifts, Dewhurst, Uniezego (EZE Lifts and Unique), Extreme Elevators, Regal Lions, Robert Gerrard and Safeline. The Safeline team was made up from Intelligent Lifts, Flex Lifts and Temple Lifts – true team spirit in the industry!

Jackson's Team B who had a 100% record in the 5 a side were joined by CTA (Cibes, Titan and Apex) in the final against Safeline/Target and after fierce competition in front of a several hundred strong audience won 2-1.

A big thank you to principal sponsors Dewhurst, PEW Electrical for the match day programme, Safeline supplied shin pads, Scott Heyward and Deltron Lifts supplied goalie gloves, BLDN clothing supplied match day bibs, Fujitec and Andy Gino supplied footballs and match day officials.

On the day there were various stands showcasing different items such as a well-being stand and mental health stand, with Petrain services providing mental health support information and useful cards which can be used to contact support services. Thanks to Petra Northwood for turning up early and helping to set this stand up.

A well-being stand had essential oils, Indian head massage, reflexology and reiki, with thanks to Patsy Charles for providing the essential oils and Anne Stuart for providing the Indian Head massage and Reiki.

A cake stand raising money for mental health, with thanks to Emily Still from EZE Lifts and Elle from Robert Gerrard.

And local suppliers were there to support with Tool Bank showcasing tools and WJ King with vans.

A big thank you to Steve Kitteridge, Kevin Toomey and Richard Wood for all their help and Martin McCarthy, a mental health educator at Our Mental Health Matters, for securing the football stadium and sponsoring the cup for the final.

Truly a unique event where so many companies within our industry came together.

Lift Industry News would like to thank Mark Harding for conceiving this event and working tirelessly to make it happen. **You can support the charity here:**

https://www.justgiving.com/crowdfunding/lift-mental-health?utm_term=9ZdybGkJx

The Lift Industry Mental Health Charter will now feature in both the L.I.T.S, and Seleta NVQ training portfolios for their new lift candidates. It will provide information on the charter and its purpose, along with sign posts to mental health support.

To introduce the mental health charter, and access to mental health support, is testament to the lift industry and the direction we are heading in regards to mental health.

Coupled with this, A&A Electrical will be purchasing and supplying our Euro health release keys to both L.I.T.S and Seleta training companies, so they can be supplied to new lift candidates. This will give the new candidates access to the Lift Industry Mental Health Charter website whilst on the move. Thanks to A&A for purchasing and supplying the keys and both L.I.T.S and Seleta for placing mental health within their portfolios.

The Lift Industry Mental Health Charter website has great mental health support links to all different types of services such as NHS mental health support, Citizens advice financial support, Red Cross financial support, NHS exercise, LGBTQ+ support, BAME and SCOPE support services.

We are always updating our site to list free support services and links.

https://lnkd.in/eRb-BF5e

SUN, CARS, AND LIFTS AT ILE IN LONDON

Åsa Magnusson, Managing Director at curzoncreative.com reports from the ILE Lift Car Fest.

The sun beamed down on Highams Park as ILE (International Lift Equipment) hosted the first ever 'Lift Car Fest' in London on June 8th. What started as an idea for a small customer gathering had quickly gained momentum and grown into a full-blown industry event as word spread throughout the lift community. Over the course of the day, the event attracted more than seventy-five people representing all aspects of the lift industry in London and beyond.

There was an abundance of chrome and polished leather on show, as attendees were encouraged to bring their classic or performance vehicles. An array of cars and motorbikes lined up in front of ILE's London distribution centre, creating a fabulous display of automotive excellence for the crowds to enjoy. Some examples included a 1972 Buick Riviera Boat Tail, a Jaguar SS100, a Ford Mustang 66 Fastback, a Cobra GT 350, a Porsche Panamera 4, an R53 Mini Cooper S, a Citroën 2CV6 Spécial, and a Harley Davidson Breakout.

As well as a barbecue with locally sourced produce and an open bar, the day also featured a highly relevant speech by Dave Cooper from LECS UK, outlining the new regulatory regime for high-risk buildings.

"It was a pleasure to speak at this event," Cooper commented. **"As consulting engineers we always welcome a platform to share information about the changes to the regulatory landscape and, hopefully, help everyone in the industry to stay abreast of these changes."**

Phil McDonnell, Technical and Commercial Manager at ILE, welcomed the crowd and took a moment to emphasise the core values of the business. Standing next to a preview banner of the new ILE brand which will be rolled out in the second half of 2023, he said "We're unique in the industry, in that we are a truly British manufacturer and supplier of virtually everything you need for the trade. We're proud of our heritage and what we've achieved over the decades. Now we are moving forward as a business, embracing new technologies and processes." Describing ILE as a technology-led, people-focused company, he emphasised the importance of the people who make it all happen. "We have an amazing team working across all our locations. Whether it's design, manufacturing, technology, commercial, warehousing, distribution, or service – our people are what truly makes ILE what it is."

GAL Manufacturing was the main event sponsor of Lift Car Fest, showcasing a range of solutions distributed exclusively by ILE, including their LWL Clutch and Car Door Interlock package. Lift car metal supplier Rimex Metal Group sponsored the refreshments, while Ziehl-Abegg also offered a display of their gearless machine solutions – along with their giveaway bright blue sunglasses which quickly became a fashion statement among the participants.

The event raised £2,000 in donations to the Lift Industry Charity, supporting the important work done to improve the lives of industry professionals and their families impacted by injury and loss. Nancy Lycett, ILE's Managing Director, was delighted to see the event so well attended.

"I'm so pleased we've been able to offer our industry an opportunity to do some informal networking and socialising. We're always more than happy to support the Lift Industry Charity, so it's wonderful to be able to do that with the help of our partners co-sponsoring this event."

A former schoolteacher, Lycett couldn't help but quip that the build-up to the event had felt somewhat like preparing for A-level day. It did however turn out to be one she will be looking back on with both pride and delight – and she's already looking forward to the next one.

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14TH LIFT & ESCALATOR SYMPOSIUM

The 14th Lift & Escalator Symposium takes place this year at the Hilton Hotel, Northampton from 20 – 21st September.

This year's programme delves into the key themes of accessibility and evacuation and takes a closer look at planning, technology, and engineering.

All the abstracts this year are listed on the next pages.

Register today

Date: 20 - 21 September 2023
Where: Hilton Hotel, Northampton

www.liftsymposium.org

Highlights include:

A keynote presentation on the principles of inclusive design from Rachel Smalley, Head of Inclusive Design at Jacobs.

A review of vertical transportation design deliverance to iconic buildings review with Jagadish Kumar.

Kevin Vinson will explore the design, manufacture, and installation of the Great Glass Elevator, lift 109 At Battersea Power Station.

Jason Godwin will present a case study on the utilisation of VoIP in lift emergency communications.

Michele Guidotti will shed light on the integration of smart buildings and IoT-enhanced traffic analysis embedded in lift sensors.

Philip Hofer will examine the technology redefining the future of elevator installation methods for high rise buildings.

Janne Sorsa will present market feedback and additional guidance on ISO 8100-32.

Stefan Voth will lead a session on exploiting the capacity of industrial hydraulic buffers from.

In addition, this year's panel discussion, chaired by LEIA's Nick Mellor, will focus on the evacuation of disabled people.

1. Enhancing the Inter-Linked Monte Carlo Simulation Method (iL-MCS) to Reflect Random Passenger Inter-Arrivals

Lutfi Al-Sharif, Al Hussein Technical University, Jordan.

The Monte Carlo Simulation method (MCS) has been successfully used to find the value of the lift round trip time under general traffic conditions, including cases such as multiple entrances, unequal floor heights, unequal floor populations, rated speed not attained in one floor journey, as well as the variation in group control algorithms (e.g. destination group control).

In conventional Monte Carlo Simulation, the various trials (or scenarios) are completely disconnected, where the end of one trial does not influence the following trial. A previous paper presented the new extension of the Monte Carlo Simulation, by inter-linking each trial or scenario in the Monte Carlo Simulation with the next one, where it links the trials such that the end conditions of one trial become the initial conditions of the following trial. This "interlinking" allows the method to reflect the effect of the random passenger destinations on the value of the round-trip time.

The previous paper examined in details the effect of the first source of randomness in the lift system: the randomness of the origins and destination of passenger. It did not however, examine the effect of the randomness caused by variable passenger inter-arrival time (the following an exponential probability distribution).

The paper will also include the effect of bunching on the value of the round trip time as well as the queue length at the landing.

2. Temperature phase plan map and Poincare section for escalators

Ali Albadri, Transport for London, UK.

Our interests in finding a tool which we can be used to understand and record the behaviour of electro-mechanical machines, is continuing in this study. We have chosen escalators in our studies because their natural electrical and systematic designs are based on systematic cyclic and periodic behaviour. Escalator nature of operation has given us an excellent platform to determine how regular or irregular or chaotic the behaviour of an escalator is, especially when some sort of malfunction develop in it. We used two tools to achieve our objectives [1-6], the fractal dimension concept and the phase plan map as well as the Poincare section.

In this study we will concentrate our affords on the behaviour of the gear box which drives the escalator. The parameter which will be looked at is the temperature of the gear box. Temperatures were measured from different locations in the gear box. The phase plan maps and Poincare sections of various traces from various temperature sensors have plotted, they have presented some interesting and useful patterns. The plots can be used as reference maps for the normal and up normal operation condition of an escalator.

3. ISO 8100-32 Brickbats and Bouquets and all that?

Gina Barney, Gina Barney Associates, Richard Peters, Peters Research Ltd, UK.

ISO 8100-32 Planning and selection of passenger lifts to be installed in office, hotel and residential buildings was published in June 2020 after seven years of development. It is not a safety standard and has commercial implications. It tries to standardize a method to size a lift installation and provide values for rated load, rated speed and number of lifts to meet a defined passenger demand. The standard was not adopted by the UK as BSI considered it to have too many deficiencies. These included allowing passenger mass (default 75kg) to define lift car occupancy in place of passenger area (default 0.21m2); a research based simulation design method to carry out installation sizing in place of traffic templates and the provision of large-scale charts which can give an inaccurate design. The standard does include the classical design method developed by Barney and Dos Santos in 1975, but uses unconventional symbology to describe it.

4. Condition-based and Predictive Maintenance Strategy for Lift Installations using Big Data Analytics

Jimmy K.K. Chan, Calvin K.F. Leung, Wayne T.H. Wong, Scotty C.H. Kwok, Electrical and Mechanical Services Department Government of the HKSAR, China.

Safe and reliable lift services are essential for maintaining high accessibility and functional vertical transportation to help preserve the vitality of a city like Hong Kong which is renowned of its densely packed skyscrapers.

This paper presents a proof-of-concept trial of a health monitoring platform for Condition-based and Predictive Maintenance of lift installations based on big data analytics. Different types of non-intrusive sensors have been implemented for measuring temperature, strain, acceleration and displacement of lifts such as the traction motor brake arms and lift car vibration. A novel design of sensing and data analytic approach that capable of early identification of faults, such as brake malfunction, lift car shaking, door malfunction and traction motor malfunction have gone through proof of concept testing. A health monitoring platform is established to comprehensively keep tracking of real time operating conditions of lift installations. Predictive models are also developed to predict the remaining useful life (RUL) for the critical components.

The health monitoring platform has been deployed in five lifts during the initial trial. The processing units collect and transmit the measured data to a remote cloud-based server where algorithms for defective components identification and predictive data analytics can be implemented. Coupled with artificial intelligence, the platform can help improve preventive maintenance and relieve the burden of servicing personnel for lift installations. This paper will share the experience, effectiveness and challenges when developing predictive maintenance strategy for lift installations.

5. Change of the dynamic elongation in steel wire rope traction systems over the lifetime, influencing factors and mitigation measures

Michael Eibel , Erich Spirgi, Lift ENGINEERING Michael EIBEL e.U. Austria.

Steel Wire Rope (SWR) constructions are still the main components used as media for a large portfolio of traction elevators. The mechanical design of SWR is defined by the steel material and the complex geometry, which can be described as a space helix layered structure.

This design defines the characteristics which are fundamental to achieve the operational requirement of elevators. Essential characteristics are the minimal breaking force, the static and dynamic elongation and the number of bending cycles projected prior reaching the discard criteria.

In this paper we are focusing on the dynamic elongation of a SWR and particular about the change of the dynamic elongation of a SWR over the lifetime. Thanks to mathematical models the deformation and elongation of wire rope under known tension can be calculated, in addition the elastic modulus of a steel rod is well defined and the definition of the elastic modulus of a rope is determined according to the ISO standard 12076.

In the practical use of SWR where several ropes are bearing the load together, there are many imperfections and influencing factors leading to a change of the dynamic elongation. This paper identifies, explains, and describes the impact of such factors.

The identification is based mainly on observation and sample measurements in real lift installations, so the impact is illustrated in a qualitative (not exact quantitative) way, using the stress-strain diagram. Since the cause of the influencing factors are identified, also corresponding mitigation measures are explained.

Ultimately when applying this mitigation measures, the deviation to the initial rope design and purpose to fulfil the operational requirement of the elevator can be minimized.

With this, the rope and rope system can stay longer within the range of the required performance, extend the lifetime, lead to longer replacement intervals, and reduce therefore the overall operating costs of elevators.

6. Study on the concept of using lifts and escalators in evacuation routes using fragility assessment (Damage Analysis and Pedestrian Simulation)

Osamu Furuya, Ryusei Nakajima, Tokyo Denki University, Japan.

In Japan, seismic design has been adopted for buildings on the ground surface and important mechanical structures. However, few studies have examined the maintenance of system functionality during earthquakes by considering the building and machinery within the building as a single system. For example, during strong earthquakes, not only the building itself is damaged, but also various piping, electrical cables, air conditioning equipment, elevators, and other mechanical elements within the building that maintain the function of the building system are often damaged, resulting in the failure of the building's function. In addition, the impact of such damage on evacuation routes can be significant. Elevators and escalators, which are always used for human flow, cannot be used in evacuation routes.

In the event of a disaster, lifts and escalators are designed to quickly move to the nearest floor and unload passengers, and escalators may stop suddenly when an abnormality is detected, such as in the event of an earthquake. In any case, the escalators are not yet ready to be utilized as evacuation routes.

This study examines the concept of appropriate evacuation routes based on pedestrian simulations considering damage events to mechanical structures related to the selection of evacuation routes, assuming the escalators after the revision of the seismic design standards reported in the previous paper. In this paper, pedestrian simulations in a 40-story high-rise building are conducted to quantitatively evaluate the time required to complete evacuation and to analyse the effectiveness of using escalators and elevators for rapid evacuation.

As a result, it was confirmed that the building model used in the present analysis can achieve a time reduction of about 300 seconds compared to a staircase evacuation, and that the use of escalators and elevators can achieve an evacuation time reduction of about 70 seconds for every 10 stories.

7. Connected lifts. Value for maintenance

Julio Gil, Macpuar (MP Lifts), Spain.

In the current era of communications, computing, data processing capacity and the Internet of Things, industry in general and industrial equipment maintenance services are forced to change their operating processes to adopt and take advantage of this technology. All this represents a greater revolution than the one caused by the steam engine in the 19th century.

This revolution represents a huge technological leap whose use necessarily involves reinventing business processes and services.

In the elevation sector, there are different issues to solve:

1. Sensors. Combination between standard sensors (independent or not from lift working) and information got from each controller.
2. Solving they way this information is captured within the lift, to be transmitted outside and the way to receive information to be "ordered" to the lift.
3. Communication level. Specially focused on security (to avoid non controlled traffic of information).
4. Platform to receive/analyse/send information to the lift.
5. Added value/services around the platform.

Nowadays, these are different technologies with few technological companies having technical capacity on all of them, so real technical value is integration of all of them. The different ways on technical integration have impact on business model to build around them and type of services to provide to the different stakeholders around these services. From technical point of view the most important challenge has been the integration of all these level than compose IoT for lifts and capacity to act over different types of lifts.

An ecosystem was created with all these technical elements, with different technologies and partners to add value to this ecosystem.

8. Classification and recognition of roller bearing damage in Lift Installations using supervised machine learning and vibration analysis

Mateusz Gizicki, Professor Stefan Kaczmarczyk, Diana Dringa, University of Northampton, UK.

In lift installations, suspension ropes pass over rotating components such as traction sheaves and diverter pulleys. These components are subjected to large cycling / dynamic loading conditions due to the rope tension forces. Those conditions, combined with potential loadings due to rotating unbalance, affect roller bearings, which often suffer from fatigue resulting in their damage and failure.

An experimental laboratory rig comprising a rotating disk-shaft assembly with seeded damage (disk unbalance and roller bearing components with damage) has been developed. The rig is instrumented to collect vibration data by using accelerometer sensors. Vibration features are then extracted from the vibration signals and are used in supervised machine learning (ML) to train artificial neural network (ANN) models to recognize patterns and classify the damage.

9. Utilization of VoIP in Lift Emergency Communications – A Case Study

Jason Godwin, 2N, Czech Republic.

The use of VoIP is set to become the predominant industry standard for emergency voice communications with lifts in this decade. Already networks are VoIP driven with radio network backhauling, SIP trunked connections and applications like Skype, Microsoft Teams and many other using this now very proven IP-based form of digital communication. The advantage of VoIP over analogue or even operator specific VoIP derivatives like VoLTE (Voice-over-LTE) is that end-to-end QoS protocols can be applied to lift call quality and associated media like DTMF signalling. This paper will introduce the topic of VoIP for lift emergency communications, lift industry examples of utilization current or planned, and present a case study using the Cairo Monorail project currently being implemented as a example of such technology deployment and the benefits offered. Finally, there will be a brief discussion of the impact regarding EN81:28 in respect of VoIP utilisation and advice on how this topic can be supported at a national and European level with the ultimate goal of assisting industry stakeholders, particularly lift consultants specifying communication solutions and independent lift installers and maintainers who might be unaware of technological advances that can benefit themselves and their customers.

10. Multi-Level Edge Architecture for Machine Learning Deployment in Edge Devices

Marco Gonzalez-Hierro, IKERLAN, Spain.

The application of Machine Learning (ML) techniques to improve operation and maintenance is one of the most promising research fields in computer science. However, the deployment of ML models in elevator systems presents unique challenges, such as limited computing resources, a variety of communication interfaces, and real-time operation requirements. To address these challenges, a multilevel edge device architecture offers a promising solution for deploying ML models in embedded devices.

Leveraging a multilevel edge architecture, ML models can be deployed on different devices in an elevator installation, taking into account the optimization of the models for execution on embedded devices with heterogeneous performance capabilities. The architecture comprises a first level of Edge devices with connectivity and capability to deploy microservices from the cloud and a second level of resource-constrained Internet of Things (IoT) devices that provide an interface to update TinyML models optimized for local execution. The first level Edge devices provide a gateway mechanism between the cloud and IoT devices and enable offline operation of the infrastructure, allowing IoT devices to continue their normal operation.

11. Smart buildings: IoT-enhanced traffic analysis embedded in lift sensors

Michele Guidotti, Cedes, Switzerland.

From manual people counters to 3D camera imaging, the traffic analysis technology has come a long way in the last few decades. Today, the people counting function can be embedded in smart devices designed for other purposes, such as light curtains and time-of-flight camera sensors for lift door safeguarding. Computed and visualized thanks to IoT, the sensor data can have numerous applications, including lift usage optimisation and predictive maintenance based on wear and tear. (A more recent example would be implementing public health measures in times of pandemic, where the lift should only be used by one person at a time.) However, the potential of traffic data collected by lift sensors goes beyond the lift itself: it provides valuable insights on people flow in the building as a basis for informed maintenance and business decisions, energy saving and building usage optimisation. The lift is becoming an important part of the smart building ecosystem.

12. Technology redefining the future of elevator installation methods for high rise buildings

Philip Hofer[1], Miguel Castro[2], Urs Püntener [2], [1]Jardine Schindler Group, Hong Kong, [2]Schindler Elevator Ltd, Switzerland.

The Installation of Lift guiding systems are fundamental to the ride quality felt in the car. This paper will look at typical elevator installation methods and the technological journey of elevator installation in the construction business. Traditionally elevators were installed by fitters using scaffolds to access the hoistway, aligning the guide rails and adjusting the distance between them. The process was often quite challenging for the installation teams as safety was the main concern along with the physically strains, working in a harsh environment. The process then progressed further to Scaffold-less installation methods with temporary suspended platforms, that offered improved safety standards according to the guidelines defined in EN 1808 & GB T 19155.

At the same time climb elevators were developed as the building industry required elevators to be installed and operational whilst the buildings were progressing in the construction phase. Today new technology has allowed robots to become mobile, leaving the factories for robotic installation systems for lifts on construction sites. The repetitive tasks and harsh environments that challenged humans can now be done with the high quality and precision of robots.

13. Discussion on Express Zone and Destination Control for Up Peak Traffic

Takahiro Ishikawa, Shingo Kobori, Yasuhiro Yokoi, Kenji Taniyama, Naohiko Suzuki, Mitsubishi Electric Corporation, Japan.

Various policies are used in lift group control systems to provide good services to passengers at the main floor during up peak traffic. One of the most commonly used policies is so-called destination control system, in which the destination floors covered by each car are dynamically decided based on the destination information entered by passengers at a lift hall. The destination control system is expected to improve the average waiting time and the handling capacity by combining with an express zone which efficiently carries passengers whose destination floors are near. This paper shows the formulation of up peak equations of the destination control system and the combination system with an express zone, and evaluation results by numerical experiments.

In the experiments, the distribution of the destination floor P(i) is expressed as the cumulative distribution function of the truncated normal distribution with a mean μ and a standard deviation σ. The handling capacity and the average waiting time for the destination control system and the combination system are evaluated while changing standard deviation σ. Numerical results show that the destination control system is superior in the distribution with a small σ where passenger's destinations are non-uniform. On the other hand, the combination system is superior in the distribution with a large σ where passenger's destinations are uniform.

14. STH BNK by Beulah - a case study of VT design challenges

Mateusz Jankowiak, Arup, Australia.

This paper aims to take a closer look at various vertical circulation challenges associated with the ongoing design of STH BNK by Beulah development in Melbourne, Australia. Currently, the complex consists of two towers connected by a common podium and features a vast range of offerings.

The 101-storey (368 m tall) East Tower would become the tallest in Australia and will include luxury residential units as well as a publicly accessible Conservatory at the top of the building. The 63-storey (290 m tall) West Tower will feature a luxury hotel and hotel branded residences located above commercial office levels. The 9-level podium will include mixed retail areas, several restaurants, wellness facilities, a childcare centre, a large auditorium, a high-end exhibition centre along with a rooftop public garden. The complex's 7-storey basement will include commercial and residential loading bays as well as car and bicycle parking.

Midway through the concept design stage, adjacent property was added to the site resulting in the West Tower and the Podium increasing in size and the East Tower having hotel branded residences introduced requiring dedicated circulation while maintaining the original core design.

The current vertical transportation design for the overall complex includes approximately 60 lifts and 25 escalators. All commercially available technologies are being considered in the design including TWIN, double-deck, single-deck and machine-room-less lift arrangements. Sky-lobby approach is used for the hotel in the West Tower with the guest lifts on upper levels being stacked above the office lifts for core efficiency. Destination control is being using in the East Tower in order to allow separate circulation of hotel branded and traditional residents.

Given the physical constraints of the site, active traffic management of some of the publicly accessible facilities as well as other design compromises may be required to balance functionality with constructability.

15. On the Mechanical Interactions in Suspension Rope – Sheave / Pulley Systems

Stefan Kaczmarczyk, University of Northampton, UK.

Steel wire ropes (SWRs) employed as suspension means in lifts systems are subjected to bending when passing around rigid traction sheaves / diverter pulleys. A suspension rope can be represented as a moving Euler-Bernoulli beam and its mechanical interactions at the contact area are then described by a nonlinear Boundary Value Problem (BVP) model with unknown boundaries. The BVP can be solved numerically and the solution yields the span shape, curvature values, slope angles and the distribution of tension along the rope span. Due to the bending stiffness the wrap angles are decreased and the distribution of tension becomes nonuniform. It is shown that this results in the tension being increased which affects the traction conditions and useful life of the ropes.

16. Vertical transportation design deliverance to iconic buildings

Jagadish Kumar Vimmadisetti, Lavenir Consultancy PVT Ltd. India.

Objective - ”Delivering a safe, healthy and sustainable built environment buildings that perform” comprehensively capture the essence of a highly efficient building. This paper showcases from Vertical transportation point of view , one of the most prominent projects in India - CENTRAL VISTA located in the heart of national capital, which is a modern centre of national governance.

Methodology - In any VIP building, the horizontal and vertical transportation environment becomes increasingly more important and needs to be designed in the most efficient and effective way to ensure the right balance.

Main results - In this context, the paper addresses opportunities applying new state of art technologies within a multi-disciplinary and multi-cultural environment to improve the efficiency and effectiveness of the building. The planning is done with scope for future expansion, exploring the new built typologies.

Conclusions - This paper finally provides comprehensive outlook on presenting an in-depth analysis of state-of-the-art methodologies deployed for safe and smooth vertical transportation in terms of Passenger comfort, code complaint, energy efficient products, sustainable maintenance procedures, IoT deployment to maximise the built potential and yet be modern and iconic.

17. Activities and Results of the Rope Vibration Working Group in the Japan Society of Mechanical Engineers

Keisuke Minagawa, Satoshi Fujita, Saitama Institute of Technology, Japan.

Resonance of wire ropes or cables in a lift due to earthquakes and strong winds is a critical event for the safe operation of the lift, because if the ropes catch equipment in a shaft by the resonance, the passengers will be trapped and it will take a long time to rescue them. To prevent damage caused by rope vibration or resonance, it is important to estimate the vibration of ropes by simulation analysis in advance.

However, simulation method of rope vibration is complicated because it consists of various eigenmodes, the tension is not constant due to its own weight, and it is influenced by various factors, resulting in nonlinear vibration. Therefore, the Panel of Elevator Safety and Reassurance of the Japan Society of Mechanical Engineers (JSME) established the Rope Vibration Working Group. The working group studied simulation methods for rope vibration. This paper reports on the activities and results of the working group.

18. The Global Dispatcher

Richard Peters,
Peters Research Ltd, UK.

A modern lift traffic control system, often known as a dispatcher, can collect passenger calls in several different ways. Conventional dispatching uses up-and-down buttons on the landing with additional buttons for each floor in the car. Destination control dispatching uses destination input devices on the landings so that passengers can select their required floor when the lift is first called. Hybrid dispatching systems use a combination of landing call buttons, car call buttons and destination input devices. Aside from a range of input devices, advanced dispatchers may manage single and double-deck lifts, multiple lifts in the same shaft, and a combination of these lift types within a lift group. This paper describes how the same dispatching software can manage all input devices and lift types by applying a unified approach to lift dispatching. The core software is built on a software model of a lift controller, which itself can manage all lift and call types. Unknown information, for example, future car calls once a landing call is answered, is predicted. The choice of which lift serves which call is made by applying a simulation model, which assesses the outcome of alternative allocations the dispatcher could make. The Global Dispatcher applies the Global Dispatcher Interface.

19. The need for standardised metrics and KPI's for AI performance

Dr Rory Smith, University of Northampton, USA.

The use of Artificial Intelligence (AI) in the lift industry is becoming commonplace. It along with remote monitoring, is being applied to lift and escalator maintenance. Some governments who require monthly or twice monthly maintenance now only require quarterly maintenance if remote monitoring and AI are utilized.

The benefits of AI augmented maintenance such as increased up time, improved first time fix rate and fewer running on arrival (ROA) calls are being touted by governments and lift companies alike. However, no standardised set of metrics exists for these benefits.

A set of metrics for lift and escalator maintenance is proposed and discussed.

20. Market feedback and additional guidance on ISO 8100-32

Janne Sorsa[1], Richard Peters[2], Arthur Hsu[3], [1]KONE Industrial Ltd, Finland, [2]Peters Research Ltd, UK, [3]Otis, USA.

ISO 8100 Part 32 is a new international standard published in 2020, addressing the planning and selection of passenger lifts for installation in offices, hotels, and residential buildings. The standard describes two methods to determine an appropriate lift installation: traffic calculation and simulation. Guidance is given on inputs to the analysis and how to review its results. A Technical Report is being prepared to support the application of the standard. In preparation for this work, a survey was undertaken to help understand the application of the standard and how the authors could best support its use. The survey results provide insights into how people engage with the standard and what additional guidance needs to be provided. This paper summarises the feedback and the scope of the additional guidance which will be included in the Technical Report.

21. Elevator Evacuation of Tall Buildings

Peter Sumner, WSP, UK.

The general rule 20 years ago was to evacuate building occupants by stairs alone although, all tall buildings had Emergency Elevators to assist the Fire Service in fighting fires, they were not generally used for evacuation. Post 9/11/2001, there has been an awakening to the need to speed up and make safer the evacuation of all building occupants and many tall buildings now contain Elevators designed for Evacuation and in some cases special Evacuation Elevators.

Back in 2002 I wrote a paper entitled "Fire-fighting and Evacuation Lifts. Exploring the Concept of using Lifts to escape building fires", and have championed the need to design Elevators, and Elevator systems to assist the evacuation of tall buildings ever since. This paper expands on my early work and discusses the design process that is required to incorporate Elevator Evacuation into the design of tall buildings.

22. Design, Manufacture, and Installation of The Great Glass Elevator, Lift 109 at Battersea Power Station

Kevin Vinson, Otis, UK.

The technical challenges involved in designing, manufacturing, installing, and commissioning a unique London experience that enables 40 persons to enjoy 360° panoramic views while travelling inside one of Battersea Power Station's iconic chimneys are outlined in this paper. The safe evacuation of passengers from the viewing platform at any point within the chimney, which lacks an alternative exit level, is discussed, as well as the integration of three independent units into a single unified machine, including the Panorama Lift, Access Platform within the Panorama lift, and MIP mobility-impaired persons/rescue lift. The complexities of certifying a one-of-a-kind lift machine through an EC Type Examination (Machinery Directive) process, involving special derogation from the relevant government department, are also explored. Although a particular company carried out the project, the focus of this paper is to present the technical challenges and solutions involved in delivering this iconic project.

23. Exploiting the Capacity of Industrial Hydraulic Buffers

Stefan Vöth, Technische Hochschule Georg Agricola, Bochum, Germany.

Industrial hydraulic buffers are standard equipment for industrial machinery. They are used for reduction of impact loads on structures during processes of kinetic energy reduction. This is realized by a more or less constant buffer force acting along the stroke of the buffer typically. The product of buffer force and stroke results in the energy to be dissipated during a buffering process. This serial approach does not consider the real potential of hydraulic buffers. The contribution considers basics of hydraulic buffer technology, the question of a non-constant buffer force and the potential arising with this option.

THE EFFECT OF ARTIFICIAL INTELLIGENCE ON SERVICE OPERATIONS AND SERVICE PERSONNEL

LIFT & ESCALATOR SYMPOSIUM

This paper was first published at the 13th Symposium on Lift and Escalator Technologies, 21-22 September 2022, organised by The Lift and Escalator Symposium Educational Trust. For more information see ***www.liftsymposium.org***

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Keywords: Artificial Intelligence, Machine Learning, Internet of Things, Urbanization.

Abstract: Artificial Intelligence (AI) can significantly change service operations. The timing of when service personnel are sent to lift installations and what those technicians do when on site will change. These changes are explored.

If the service tasks performed are different, one can conclude that the skill sets of the technicians will also need to be different. The skill sets and training requirements of service technicians and service supervisory personnel are also explored.

Global urbanization, post-pandemic workplace conditions, and AI will all affect the quantity of technicians required globally. These factors and their influence on staffing are reviewed.

1. INTRODUCTION

The proper functioning of lifts and the effectiveness of service operations are highly dependent on the service technician's capabilities. The technician must have the skills, tools, parts, materials, and support to properly perform service and repair functions.

Virtually all successful lift service companies, regardless of their size or location, have developed policies, practices, and procedures to deliver quality services. However, new technologies such as Machine Learning (ML), the Internet of Things (IoT), and Cloud computing will require significant changes in the service delivery system for these service providers to reap the benefits of these new technologies.

Three areas will be explored as follows:

1. The service tasks that will be performed and when they will be performed.
2. The skills and training that will be required for the next generation technician.
3. The quantity of service technicians that will be required for the post-pandemic data driven service world.

2. MACHINE LEARNING FOR LIFTS

Machine Learning involves gathering data, processing that data using algorithms and then recommending maintenance tasks and proactive actions to prevent breakdowns.

The following are some of the typical types of data used for ML [1]:

1. Static Data.

   a. Lift details such as capacity, speed, number of landings, travel, door type, drive type, and any other attribute that defines the lift.

   b. Building location.
      i. Latitude.
      ii. Longitude.
      iii. Altitude.

   c. Building type: office, residential, hotel, hospital, factory, etc.

2. Usage data.

   a. Trips made.
   b. Kilometres travelled.
   c. Door cycles per floor.
   d. Relevels.

3. Operational data

   a. Operating mode: automatic, independent service, fire service, emergency power, etc.
   b. Error codes generated.

4. Sensor data

    a. Vibration data.
    b. Ride quality.
    c. Temperature.
    d. Humidity.

The following are typical analytic tools used to evaluate data:

1. Classification And Regression Trees (CART).
2. Artificial Neural Networks (ANN).
3. Deep Learning.
4. Anomaly Detection.

3. SERVICE TASKS AND TIMING

3.1. SERVICE TASKS

3.1.1. PRESENT SYSTEM, PREVENTIVE MAINTENANCE

Most companies assign a technician a list of units to be serviced and the frequency of service for each unit. For example, units may be serviced weekly, twice monthly, monthly, or quarterly.

A specific number of hours to be spent for each visit is also included in the assignment.

A maintenance chart is commonly prepared that indicates what items should be inspected and what items should be serviced on each visit.

3.1.2. INSPECTING VS. SERVICING

It should be noted that inspecting, whilst it is important, leaves the lift in no better condition than it was in before the inspection.

Servicing, however, involves adjusting the component, replacing worn parts, lubricating parts, and cleaning the component. When the servicing is completed, the component should be in an as new condition.

3.2. TIMING AND DATA DRIVEN MAINTENANCE

With Data Driven Maintenance, the technician is given a list of sites to visit on the next day. For each lift, a list of tasks to be performed during the visit is detailed. Most of these tasks will involve servicing a component rather than inspections.

Most inspections can be performed by using machine learning. For example, door tracks and door rollers will not be inspected if the door vibration signature is normal, and the controller has not issued any door related error codes.

If the door vibration signature indicates a contaminated landing door track at the Car Park level, which is open to the building exterior, then a service task for that door track will appear in the service task list [2].

Some maintenance tasks will be scheduled based on usage. However, usage data may be combined with environmental and building type data.

For example:

> Experience has indicated a particular type of door lock should be serviced after 15,000 cycles. Since door cycles can be counted, each floor potentially will require service at a different time. The lobby floor doors obviously need more frequent service than the doors of a partially occupied floor. Additionally, from job data it can be determined that this lift is located at a tropical seaside resort where the landing doors open to the building exterior. In such environments, doors need to be serviced every 5,000 cycles.

Breakdowns will be reduced because AI will create alerts that inform the service technician of impending failures sufficiently in advance of the failure that a visit can be scheduled to take preventive actions [3]. A scheduled repair or replacement can be performed at a lower cost than a repair that must be completed before the lift can be returned to service. All breakdowns inconvenience the client. Breakdowns that entrap passengers are especially inconvenient.

Data driven maintenance requires a far more complex maintenance scheduling system. However, such a system can deliver the proper amount of service at the proper time thereby improving both operational efficiency and customer satisfaction.

4. SKILLS AND TRAINING

Data Driven Service requires technicians and supervisory personnel that have the additional skills needed to perform this type of maintenance properly and safely. The skills required are as follows:

1. Basic mechanical, electrical, and electronic knowledge, and skills. These are the same skills currently required for lift maintenance. These basic skills are required because the lift is still performing the same functions of moving goods and people as it did before the introduction of IoT. Additionally, machine learning will not eliminate the basic oiling, greasing, and cleaning of lift equipment.

2. Computer literacy. It is logical to assume that the current and future generations of service technicians are computer and smart phone literate. However, in some markets, training in this area might be necessary.

3. Probability and Statistics. Whilst most lift service technicians are familiar with descriptive statistics, few have an appreciation of inferential statistics. Artificial Intelligence is based on inferential statistics. A basic understanding of this subject is necessary if only to appreciate that predictive analytics will always be a work in progress.

4. Vibration. The fundamentals of vibration will need to be understood. Accelerometers are being used to measure ride quality, kinematics, and to identify defective or damaged components. **Important topics are:**

   a. Natural Frequencies.
   b. Resonance.
   c. Fast Fourier Transforms (FFT).
   d. Vibration signatures

5. Sensor Technology. Various types of sensors will be used to gather information that will be used by machine learning algorithms. A basic knowledge of the following types of sensors is required:

   a. Accelerometers.
   b. Barometric sensors.
   c. Temperature sensors.
   d. Humidity sensors.
   e. Strain gauges.
   f. Photo-electric sensors.
   g. Hall effect sensors.

6. Radio Frequency fundamentals. Most IoT systems are using some form of wireless communication. In addition to cellular modems for cloud connections, other low power wireless methods are being used to communicate with remote sensors. Future technicians will need to have some knowledge of the following:

   a. Frequency and Wavelength.
   b. Antenna fundamentals.
   c. Ground planes.
   d. RF cabling.

7. Electro Magnetic Compatibility (EMC). EMC fundamentals, both emissions and immunity, need to be understood. Particular attention must be given to installation methods and earthing.

5. MANPOWER REQUIREMENTS

5.1. URBANIZATION

Future manpower requirements will be driven primarily by urbanization.

Urbanization is the migration of people from rural areas to cities [4]. Urbanization began with the appearance of the first true cities in Mesopotamia around 5,500 BCE [5]. The technological explosion that was the Industrial Revolution led to a significant increase in the process of urbanization.

The Industrial Revolution began in the UK in the 18th century [6]. Urbanization soon followed as can be seen in the following chart:

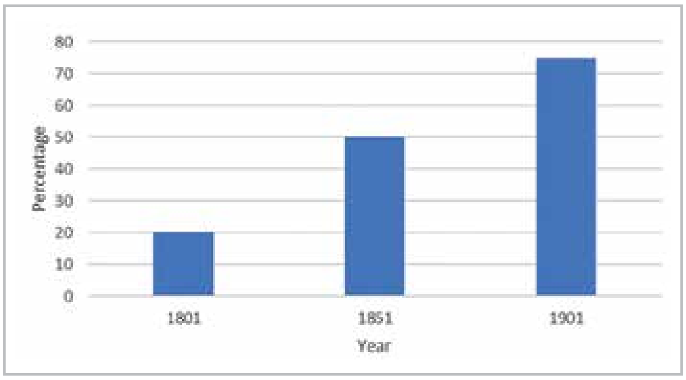

Figure 1 Urbanization Percentage

Note that the percentage of the UK population living in urban areas increased from 20% to 75% [7].

To accommodate urbanization, cities must grow upward rather than outward in order to reduce transportation time, transportation related carbon emissions, and the consumption of green spaces [8]. Upward growth implies taller buildings and more lifts. When one thinks of urbanization one immediately thinks of China and India. In China the number of people living in cities will increase by 108 million in the next eight years [9]. In the next eight years, India will see 102 million more people living in cities [9].

Urbanization is continuing even in highly developed countries. In the next eight years, the USA will see 21.7 million more urban residents whilst urban areas in the UK will need to accommodate an additional 3.5 million people [9].Urbanization will cause the number of lifts and the number of floors served by each lift to increase almost everywhere, even in highly developed countries.

The easy and inefficient way to deal with this additional demand for service technicians is to hire more people. The efficient way to cope with the demand is by using AI and by employing better trained technicians. Economic data indicates that the increase in efficiency of service operations will also result in increased real wages for service technicians [10]. The number of labour hours worked for any given lift will decrease whilst the total number of hours worked in the lift industry will greatly increase due to the combined effects of increased efficiency and urbanization.

5.2. POST-PANDEMIC WORKING CONDITIONS

The COVID-19 pandemic will influence urbanization and office space requirements [11].

A portion of the office population will work remotely. Hybrid working, where workers work remotely a percentage of the time and work from their offices the balance of the time will be common. Remote working whether full time or hybrid will create an initial increase in office vacancy. Some of the surplus will be offset by workers requiring more individual space. Social distancing can reduce the transmission of disease whilst the additional work area improves productivity. The effects of remote working and workers' requirement for more personal space will only slow the rate of urbanization until the surplus space is absorbed.

6. CONCLUSIONS

Artificial Intelligence will change the timing and frequency of service. This will result in improved customer satisfaction and operational efficiency.

Lift service technicians will need additional training to acquire the skills required for Data Driven maintenance.

Urbanization will cause more lifts to be placed into service. Additional lift technicians will be needed in the immediate future as the improved labour productivity made possible by AI will not keep up with the increased demand for technicians.

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BIOGRAPHICAL DETAILS

Rory Smith is Visiting Professor in Engineering/Lift Engineering at the University of Northampton and a Consultant at Peters Research Ltd. 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 Machine Learning, Traffic Analysis, dispatching algorithms, and ride quality. Numerous patents have been awarded for his work.

LIFT & ESCALATOR SYMPOSIUM

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THE SPACE ELEVATOR CONCEPT AND DYNAMICS

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Keywords: space elevator, carbon nanotubes, access to space.

Abstract: The Space Elevator or Space Lift is a radical technology for accessing space and the ultimate Earth-bound slender structure. The concept was first published in 1960 and was subsequently popularized in science fiction stories. After the discovery of carbon nanotubes in 1991 and subsequent calculations and measurements of their strength, the Space Elevator concept moved from the realm of science fiction to science possibility.

The Space Elevator is conceived to be a carbon nanotube ribbon stretching from an Earth station in the ocean on the equator to far beyond geosynchronous altitude. This elevator co-rotates with the Earth. Climbers ascend the ribbon using power beamed from Earth to launch spacecraft in orbit or to other worlds. The requirements of the ribbon material, challenges to the building of the space elevator, deployment, oscillations, design variations and the promise of the space elevator are briefly discussed in this paper.

1. INTRODUCTION

This paper begins with a description of the space elevator (SE) based upon the conceptual outline described in the book, The Space Elevator[1] by Edwards and Westling. This concept involves a meter-wide carbon nanotube (CNT) ribbon thinner than a sheet of paper that extends from a point on the Earth's equator to 100,000 km above that point to a counterweight. To use the ribbon to access space, mechanical climbers ascend the ribbon laden with payloads. Power for these climbers is expected to be beamed from the ground in the form of infrared, laser energy.

The center of mass of the system resides near geosynchronous altitude, thus the system co-rotates with the Earth. The counterweight, in uniform circular motion around Earth, provides a restoring force. At geosynchronous altitude the ribbon is widest because the forces are greatest. Below geosynchronous Earth orbit (GEO), the net force on a ribbon segment is toward the earth and the tensile strength of the segment must support all below it. For a ribbon segment above GEO, the net force is away from Earth and a segment must hold all segments beyond itself. As a climber ascends the ribbon, tension in the ribbon provides a restoring force that continually increases the angular momentum of the climber.

The SE system is analogous to a railroad and is subject to the economy of scale. Once the rails are laid, the cost to transport across the system is low. Chemical expendable rockets cost approximately $10,000 per kilogram to low Earth orbit (LEO). With the SE system, it is expected that the cost to LEO would fall by a factor of 3 with the first elevator, and later fall by factors of 10 and 100 as a space elevator infrastructure of larger capacity elevators are constructed. The cost to middle Earth orbit (MEO) and GEO would decrease by a greater factor. This dramatic drop in launch costs enabled by a space elevator infrastructure will enable the exploitation of space to solve Earth's problems.

The SE is a new paradigm for accessing space and as such is an enabling technology. Commerce in space including power generation, tourism, manufacturing, mining and commercial/government exploration will be developed because transportation will have dropped to a small part of the cost of the enterprise.

2. HISTORY AND MATERIALS

Many individuals may have conceived of an SE since the concept is a part of human consciousness. The Tower of Babel, Jack and the Beanstalk and references to "stairways to heaven" have existed for a long time. More recently, the academician, Konstantin Tsiolkovsky, a Pole living in Russia around 1895, wrote of towers extending from Earth up into the cosmos while visiting Paris and seeing the Eiffel Tower. In 1945, Sir Arthur C. Clarke patented the geosynchronous satellite and pointed out its usefulness for communications. There is a report that an American, John McCarthy, studied a "Skyhook" in the early 1950s.

The first published discussion of an SE-like structure was by the Russian engineer Yuri N. Artsutanov[2]. In 1960 he published a short article in Pravda for children. The concepts and numbers presented in this article make it clear that he understood the concept and had done calculations to back up his statements. The first journal article was published by four scientists from Woods Hole Institute[3] in 1966. Presumably the long cables that oceanographers used to explore ocean trenches inspired the authors to apply this technology to space. The last person to discover the space elevator was Jerome Pearson in 1975. Pearson published the most detailed physical study[4] at that time and has continued to investigate the concept up to the present.

These discoverers understood the promise of the SE. But they all recognized that no material existed that was strong and lightweight enough to manufacture the SE ribbon and make the SE a reality. Therefore, the SE existed in many forms in science fiction for many years[1].

In 1991 Iijima[5] discovered carbon nanotubes. CNTs have been reported theoretically to possess a tensile strength in the range of 300 GPa[6–7]. The Earth SE ribbon requires around 100 GPa of tensile strength minimum[1]. An actual ribbon would be built with strength contingency so consider 130 GPa or higher as the required strength. Thus, this new CNT material offers, for the first time, the possibility of building an SE ribbon.


В космос —
НА ЭЛЕКТРОВОЗЕ

Figure 1 The first Space Elevator article in Pravda

A macroscopic SE ribbon could be formed with CNTs by spinning individual fibers or by forming CNTs into a composite material. CNTs are essentially inert and do not want to form bonds between them. Only weak, ionic Van der Waals bonding operates between the individual CNTs. Its source is the electrical "landscape" on the surface of a CNT and are additive in the sense that the more and more regions along a CNT that are experiencing Van der Waals forces, the stronger the overall attraction. Spinning of nano-scale CNTs requires long tubes (possibly millimeters or centimeters) so that the weak Van der Waals forces are effective over a length sufficient to provide strong bonding between tubes. Handling nano-scale fibers is a challenge so spinning CNTs into micron size threads is another option. Using CNT composites to form the ribbon possess other challenges that include the chemical bonding of the CNTs to a matrix material, achieving uniform distribution of CNTs throughout the matrix and the alignment of the CNTs in the matrix.

Whatever technique is adopted for the SE ribbon, the process must be adaptable to manufacturing so that 100,000 km of ribbon can be fabricated in a timely fashion. Indeed, realizing the fantastic physical properties of a single CNT in a macroscopic assemblage of CNTs is currently impossible, but undergoing intense research. Currently, CNTs are an expensive material from which to make any macroscopic object because a typical cost for 5 micrometer long, single walled CNTs is around $12 per gram! The cost of CNTs must drop dramatically before an 800-ton SE cable can be manufactured cost effectively.

3. DEPLOYMENT SCENARIOS

In 1999 NASA held a conference on the SE. The scenario that emerged from the meeting was similar to Arthur C. Clarke's scenario in the Fountains of Paradise: an asteroid would be captured and placed into GEO around the earth. The carbon on the asteroid would be used to build a massive, CNT tower from the asteroid down to Earth's surface. Four magnetically levitated trains would run up the tower at very high speeds, delivering people and cargo to the GEO station. The asteroid would end up slightly above GEO to preserve the center of mass residing at GEO and would act as a counterweight. One estimate of the time to realize this vision was 300 years! As an astronomer, the author of this paper can assure you that it would take at least 300 years to convince astronomers to let a large asteroid that close to the Earth!

Now there is a "bootstrapping method" being developed for the deployment of the first space elevator – a major effort no matter the method used. The basic plan is to launch the components, deployment spacecraft and pilot ribbon, into LEO. This will take many launches as even a narrow (about 20 cm) ribbon and its deployment spacecraft are massive. Modern rocket launch vehicles do not have the capacity to carry such massive payloads to LEO in a single launch. In LEO the system is assembled possibly with the help of astronauts. Then the system must be lofted to GEO above the desired point on Earth, probably the ocean on the equator about 300 km west of the Galapagos Islands.

Two possible scenarios are being considered to thrust the system to GEO. The first scenario is to launch all the fuel to LEO and use an efficient high specific impulse engine to rocket the system to GEO. This increases the required number of launches. The second scenario is to launch propellant for an engine (say an ion engine) and then beam the power up to the system from 3 or more power beaming stations floating on the Earth's oceans. These stations will eventually converge on the ground point and be used to power climbers up the ribbon. The second scenario will require fewer launches and will prove the capabilities of the power beaming system.

Once the system is at GEO over the ground station, the ribbon can be let out. The end will need a small propulsion system to get the ribbon started toward Earth and to handle the angular momentum change as it descends. A "homing" device on the end will facilitate intercepting the ribbon and affixing it to the ground station. During the spooling out of the ribbon, the deployment spacecraft has risen above GEO so that the center of mass remains at or very near GEO. The spacecraft also must thrust to stay above the ground point because of the angular momentum change at different altitudes. Once the ribbon is completely deployed the spacecraft acts as the counterweight.

The pilot ribbon has a lifetime of only a few years because of impacts from small debris that cannot be actively avoided. Therefore, immediately, climbers must be sent up the ribbon to attach more ribbon to the SE. These climbers must be engineered for the small capacity of the pilot ribbon. As the ribbon capacity increases, the climbers will be larger and will carry more ribbon. After two years, a meter-wide ribbon rated at 20 tons (extra tension in the ribbon) would be completed. Subsequent, higher capacity SEs will be built with an existing SE in much less time, possibly 5 months. Indeed, each elevator's first task may be to build a successor ribbon thus building the SE infrastructure.

Figure 2 An artist's conception of the Space Elevator's Earthport

4. CHALLENGES

Even if the ribbon and deployment spacecraft were ready to go, there exist issues that must be dealt with before the SE can be deployed. These issues include the technologies required to ascend the ribbon, hazards to the ribbon and the problem of humans traveling on the SE above LEO.

Climbers that ascend the ribbon must operate over a wide range of environments, possess high reliability and climb the ribbon without damaging it. Climbers are assembled, loaded and launched on Earth at the bottom of the troposphere. Within the troposphere weather can be dangerous to climbers especially lightning. The regions encountered during ascent above the troposphere include the stratosphere, ionosphere, and magnetosphere. The atmospheric pressure decreases while the temperature and composition change dramatically as the altitude increases. The stratosphere extends from about 15 km up to about 55 km, the temperature increases from -51C to -15C. The ionosphere begins around 60 km and end around 1000 km. Solar radiation has ionized the atoms in this part of the atmosphere and so the climber must climb through a plasma, albeit a very tenuous plasma. The magnetosphere extends above the ionosphere far out into space. It is a very hard vacuum with very tenuous ions streaming through it. Earth's magnetic field and the solar wind effect its overall shape and boundaries by their effect on the ions. The climbers must operate in all these environments including the radiation environment of the magnetosphere. Climbers must be reliable enough to make at least one 100,000 km trip if not a round trip. A stranded climber could compromise the use of the SE.

Climbers also must have a wide range of uses and so will differ in design. Most climbers will carry and launch payloads. Others will carry out diagnostic measurements, repair tasks, ribbon laying, science experiments and rescue of stranded climbers.

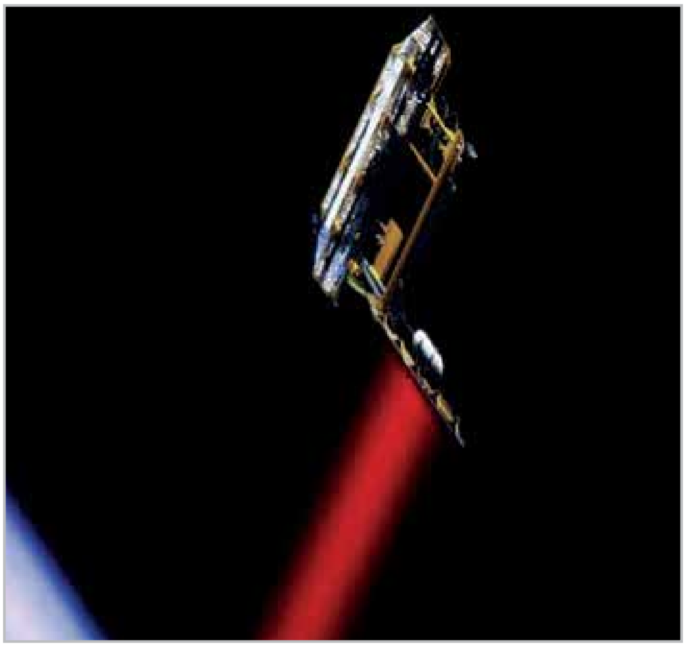

Figure 3 An artist's conception of the Space Elevator Climber ascending the ribbon near Earth and illustrating the power beaming to photovoltaic cells.

The power beaming system that will energize the climbers has three major system components: the infrared laser, the large (~12 meter) telescope and the adaptive optics system. Each of these components (or a close example) exists separately but has never been integrated and operated as a system. An adaptive optics system is required to focus the energy onto the climber photocells through the atmosphere. Current adaptive optics systems are not capable of phasing the entire aperture of large telescopes, but active, closed loop adaptive optics should achieve large aperture phasing.

Hazards to the SE include winds, lightning and aircraft in the troposphere, atomic oxygen in the upper atmosphere, and radiation, solar storms, orbital debris, orbiting satellites and meteorites in the magnetosphere. Placing the ground station on the equator in a region with few storms and defending a no-fly zone around the SE mitigate the troposphere hazards. Coating the SE ribbon with a metal such as nickel or aluminum would protect it from atomic oxygen in the upper atmosphere.

At LEO, space satellites and debris greater in size than 10cm can be avoided by moving the lower end of the elevator. Therefore, the ground station may be a ship or navigable floating platform. The width of the ribbon (1 meter) and its curved cross-section allow the SE to survive micro-meteor and small debris collisions. The statistical rarity of large meteors renders this hazard a low probability. The CNT ribbon is carbon and so is robust to most proton and electron radiation so the damage sustained should be manageable.

The climbers are envisioned to travel at about 200 km/hr. This means that the climbers spend a significant amount of time in the Van Allen radiation belts. The lower belt is mainly trapped energetic protons and the outer belt is primarily energetic electrons. Humans riding on the elevator spend so much time in the radiation belt that the radiation dose is beyond the safe level. Therefore, mitigation techniques must be developed or climbers must significantly increase in speed before humans ride the elevator beyond LEO.

5. SPACE ELEVATOR RIBBON DYNAMICS

Another hazard is the dynamics of the ribbon. This topic is of special interest to the Lift Symposium community so it was extracted from the Challenges section above and discussed here.

SE oscillations can be induced by winds, moving the ground station, the gravitational attraction of the sun and moon, solar storms, solar wind pressure, magnetospheric electromagnetic interactions, thermal heating/cooling and climbers operating on the ribbon.

The ribbon will need to be stabilized by active damping from the counterweight, base and possibly at GEO. Such active damping requires measurement of the oscillations and the appropriate application of impulses to cancel the oscillation. Accomplishing this implies a system that understands the perturbing forces and the evolution of the resulting oscillations as they propagate along the ribbon.

THE PORTION OF THE LIFT SYMPOSIUM COMMUNITY THAT CARRIES OUT DYNAMIC ANALYSES FOR ELEVATOR CABLES OR OTHER SLENDER STRUCTURES COULD FILL A VOID IN SE RESEARCH BY MODELING THE ELEVATOR CABLE DYNAMICS REALISTICALLY. THIS MODEL WOULD INCLUDE THE FOLLOWING, WITHOUT KNOWING THE SPECIFIC PROPERTIES OF THE RIBBON MATERIAL:

1. A ribbon with a changing cross section (and so changing mass/length).
2. A ribbon in which the gravitational force changes across its length.
3. A ribbon rotating with Earth by one end being attached to Earth's surface.
4. A ribbon with the other end experiencing a small restoring force in an otherwise free boundary condition.
5. A ribbon experiencing multiple perturbations along its length.
6. Sufficient resolution to model the local effects of a climber operating on the ribbon.
7. A large-scale perturbation such as a solar storm inducing a changing Lorentz force along the part of the ribbon in the magnetosphere.
8. An inelastic collision with an object.

This calculation has never been attempted, let alone approached in sophistication, by previous researchers. There is a great deal of insight to be gained by such calculations. The material properties of the ribbon could be "parameterized" so that as high strength material technology advances, the calculation could be re-run with superior material inputs until the actual ribbon material is fabricated and its properties measured.

6. SPACE ELEVATOR DESIGN VARIATIONS

Colleagues in the Space Elevator community have developed ideas about variations in Space Elevator design. Some of these involve historical variations like elevators with multiple ribbons connecting to Earth and joining into one cable at some altitude, and the free-flying skyhook orbiting Earth.

Other variations involve an adaption of the launch loop invented by Keith Lofstrom and called High Stage One. A very high-altitude platform (~80 km) serves as the starting point of the elevator ribbon thereby eliminating the hazards of the troposphere. A variation that uses similar technology to suspend the climber launch platform is the Multi-Stage Space Elevator.

Other researchers are defining the systems level view of the Space Elevator Transportation System by defining the operations and requirements of the parts of the overall system. Parts of the system include the Apex Anchor, GEO Node and Earthport.

The International Space Elevator Consortium (ISEC) holds a conference every year and has developed many study reports in which these designs are documented. One can join ISEC by going to www.isec.org. The website also has information on the ISEC Reports and other Space Elevator resources.

7. CONTROVERSIAL CARBON NANOTUBE COMMENTS

Years ago, the author of this paper left the Los Alamos National Laboratory to research CNT growth. The reason was that the progress in the field to grow long, strong CNTs appeared glacially slow.

THE AUTHOR ATTENDED A CONFERENCE PRESENTATION BY DR. BENJI MARUYAMA OF THE AIR FORCE RESEARCH LABORATORY. IN HIS PRESENTATION, DR. MARUYAMA DESCRIBED THE LIMITS OF USING THE CHEMICAL VAPOR DEPOSITION (CVD) METHOD TO GROW CNTS. HIS TEAM FOUND THAT THE CNT GROWTH WAS STOPPED AND THE CNTS WERE DAMAGED FOR THE FOLLOWING REASONS:

1. The catalyst particles from which CNTs grow become coated with amorphous carbon thereby shutting off the path for free carbon atoms to become a part of a growing CNT,
2. The catalyst particles diffuse into the substrate thereby becoming too small to support CNT growth,
3. Ostwald ripening operates on the catalyst particles increasing the size of the larger ones and decreasing the size of the smaller ones thereby rendering both of the wrong size to grow CNTs,
4. CNTs are damaged by reactions with the hot carbon-bearing gases present in typical CVD growth.

The widespread use of the CVD method in the field is why progress to grow CNTs has been glacially slow. Consequently, traditional CVD is probably a dead end. Since the discovery of CNTs in 1991, the world has poured around $35 billion into CNT research and has only an approximately $700 million annual industry to show for it!

The author spent two years of part-time work developing seven novel synthesis (growth) processes. The first six were defeated by deeper study. Proof-of-principle experiments were carried out on the seventh process, and robust growth of CNTs was achieved. Currently, money is being raised to continue to develop the technology into a process capable of industrialization. If successful, then the promise of this technology will be realized.

The promise of this technology is continuous growth of CNTs that possess pristine molecular structure – exactly what is needed to create a materials revolution on Earth. Once the technology has been developed into myriad products that change our civilization, the Space Elevator will be built as the bouquet of the technology.

8. THE PROMISE OF THE SPACE ELEVATOR

The low cost of access to space promised by the Space Elevator (SE) will enable the exploitation of space. Currently, commercial space business is only profitable in the case of communications. With lower cost to space, many types of commerce will be profitable. Solar power satellites that beam power to Earth will provide clean, inexpensive electrical power. Earth observation and scientific space missions will be expanded in number and capability. Human and robotic exploration as well as colonization will be possible at much lower cost. SEs could be thrown to the moon and Mars and deployed to enable the suppling of settlements and two-way trade.

Space tourism, bolstered by the success of the Ansari X-Prize winning Space Ship One (the first private reusable manned spacecraft to reach space twice within two weeks) will be stimulated by the SE as well. Humans will ride to LEO at first, returning either back down the elevator or by dropping off the elevator and re-entering the atmosphere. Eventually humans will vacation at the GEO station or depart from the elevator to other parts of the solar system.

In conclusion, the Space Elevator will open up space and its resources to help mankind solve its problems here on Earth and to expand into the solar system. What could be better than to work on this project? After all, now that the history of the 20th century is being written, it is clear that one of the greatest achievements was that humans landed men on the moon and returned them safely to Earth. When they write the history of the 21st century, they will say that one of the greatest achievements was the building of the Space Elevator!

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BIOGRAPHICAL DETAILS

Dr. Laubscher is a PhD in Physics with a concentration in Astrophysics. During his career at the Los Alamos National Laboratory that included R&D of astronomy projects, space mission design and system engineering, space particle instrumentation, remote sensing technologies, novel electrodynamic detection techniques and biometrics, Bryan became interested in the Space Elevator.

Pursuing the R&D of the Space Elevator has led him to start Odysseus Technologies, Inc, a small company based in Washington state with the goal of developing high strength carbon nanotube materials. Odysseus Technologies has invented a new way to synthesize carbon nanotubes and completed proof-of-principle experiments. Now the company is pursuing technology development and plans commercialization in the near future.

Bryan's current non-profit Space Elevator activities include being on the Board of Directors of the International Space Elevator Consortium and presenting the Space Elevator presentations at various venues.

Bryan now lives in Olympia, WA with his wife Carla.

LIFT & ESCALATOR SYMPOSIUM

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EXPERT SYSTEMS FOR LIFT TRAFFIC DESIGN

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Keywords: high-rise, lift, elevator, traffic analysis, calculation, simulation

Abstract: An expert system is software that emulates the decision-making ability of a human expert. Although software tools are available that automatically select a likely lift system, these designs should always be checked by an expert. This paper thus poses the question "What is required in order to develop a truly expert system for lift traffic design that encapsulates sufficient expertise for a well thought out and robust design?" The paper explores the synthesizing of the sufficient expertise of a lift traffic analysis expert and the implementation of this expertise into software. The knowledge base required, the design processes followed, and the subtleties applied when the human expert considers borderline cases are explored. The resulting "expert engine" can be used to produce software tools, or quick selection graphs and tables, based on the embodied expertise of the human expert, in order to answer specific traffic design questions within specified boundaries.

1. INTRODUCTION

An expert is a person who is very knowledgeable about or skillful in a particular area [1]. An expert system is computer software based on the expertise and problem-solving strategies of specialists in a particular field and designed to provide advice or solutions in that field [2].

An expert system is made up of a knowledge base and an inference engine [3]. These elements are obtained by interviewing expert(s). The information elicited is recorded as a rule set, typically using an "if-then" structure. The inference engine enables the expert system to draw deductions from the rules in the knowledge base.

This paper arises from an expert (Barney [4]) challenging the results of lift traffic planning graphs created by software for the draft ISO 8100-32. Lift traffic analysis and software experts (Peters, Dean) maintained that all that was needed was a complete rule set to reproduce any expert's design procedure in software.

Each time the expert challenges results generated by the software, new rules can be added to the expert system addressing the objection.

The result of this process provides an insight into the knowledge base required for an expert system for traffic design. The resulting expert engine can then be used to produce automatic lift selection software, selection graphs and tables.

An expert system is only as knowledgeable as the data sets and rules it is given. The expert system in this paper is based on the uppeak design procedure prepared for a discussion document [5]. The mathematics of the design procedure are discussed in CIBSE Guide D: 2015 [6]. The extensions to the basic procedure are not addressed, e.g. example multiple entrance floors, zones, double deck lifts, simulations, etc. all of which are within the human expert's area of expertise. Extending the expert system to cover all these areas is possible, but is not part of this paper.

2. DATA SETS AND RULES

2.1. INTERVAL AND HANDLING CAPACITY

Most design guidance documents require interpretation from an expert. For example, the required handling capacity for a residential building may be between 5 and 8% of building population per five minutes, and the interval required may be between 45 and 70 s [7] reflecting a range of expectations from “luxury” to “low income”. A solution achieving 5% handling capacity and 70 s interval will be very different from a solution achieving 8% handling capacity and 45 s interval.

For the expert system to offer a single solution, more specific criteria need to be specified, see Table 1. These values are used in the expert system developed for this paper.

Table 1 Handling capacity and interval design criteria from [5]

Building type	Required handling capacity (%POP) (persons/5-minutes)	Required lift installation interval (INT) (s)
Office	12	≤ 30
Hotel	12	≤ 40
Residential	6	≤ 60

Referring to CIBSE Guide D, this expert system developed for this paper will produce a solution which would be classified as "normal". To extend the expert system to offer "luxury" and "low income" solutions, an additional user input of a building sub-type would be required, e.g. a drop- down combo box with the options "luxury", "low income" and "normal".

The human expert might consider a ≤ 60 s interval requirement a soft boundary and may for example, consider 61 s acceptable. The programmer must determine a hard limit. Barney asked for a tolerance of 10%., e.g. for residential buildings allow up to 66 s interval.

2.2. RATED LOAD

A table of car sizes is required, with corresponding platform areas so that car loading can be determined, see Table 2.

Table 2 Rated load and platform area (source BS EN 81-20: 2014, Table 6)

Rated load (kg)	Maximum available car (platform) area (m^2)
450	1.30
600	1.66
800	2.00
1000	2.40
1275	2.95
1600	3.56
1800	3.92
2000	4.20
2500	5.00

Car selection assumes an average car loading of 80% of rated load is not exceeded where maximum car loading (persons) is determined assuming 0.21 m^2 per person in offices, 0.3 m^2 per person for hotels and residential buildings.

The above car selection methodology is appropriate in most countries. To extend the expert system to account for countries with a lower average body size, the expert system would require a drop-down combo box to select country.

Barney requested a 10% tolerance on car loading, so average loadings up to 82% will not be rejected (10% of (100-80) = 82%).

2.3. DOOR WIDTHS AND PASSENGER TRANSFER TIMES

A table of door widths is required so that passenger transfer and door operating times can be proposed, see Table 3.

Table 3 Door width and passenger transfer time for offices

Rated load (kg)	Door width (mm)	Single average passenger transfer (s)
450 – 800	800	1.2
1000	900	1.0
1275	1100	0.9
1600-2500	>1100	0.8

Table 3 is for offices. For hotel buildings 0.5 s is added to the passenger transfer time and 0.3 s is added for residential buildings.

2.4 RATED SPEED, ACCELERATION AND JERK

The preferred rated speed is calculated by dividing the lift travel by the nominal travel time as proposed in Table 4.

Table 4 Nominal travel time used in speed selection

Building type	Travel time (s)
Office	25
Hotel	25
Residential	30

The closest rated speed from the available rated speeds in Table 5 is selected, e.g. if the preferred rated speed is 2.3 m/s, then 2.5 m/s would be selected. Note the proposed values for acceleration and jerk based on experience [8].

Table 5

Rated speed (m/s)	Acceleration (m/s^2)	Jerk (m/s^3)
1.00	0.6	0.4
1.60	0.6	0.4
2.50	0.8	0.5
3.00	0.9	0.6
5.00	0.9	0.6
6.00	0.9	0.6

The flight times can then be calculated using kinematic equations [9]. A start delay of 0.5 s is assumed. Note: the tabulated acceleration and jerk values are lower than proposed in most design guidance documents following review of site measurements at a wide range of installations internationally [8].

2.5. DOOR OPENING AND CLOSING TIMES

Door widths are selected from Table 3. Centre opening doors are selected for office and hotels, side opening doors are selected for residential. Based on these selections the door closing and opening times in Table 6 are assumed.

Table 6 Door closing and opening times

Door type	Closing (s)			Opening (s)		
Width (mm)	800	900	1100	800	900	1100
Side	3.0	3.3	4.0	2.5	2.7	3.0
Centre	2.0	2.3	3.0	2.0	2.2	2.5

A door pre-opening time of zero seconds (0 s) is assumed.

2.6. NUMBER OF LIFTS

The number of lifts is selected in the range one to eight. Larger groups are unusual and require special considerations which are not addressed by this expert system.

2.7. NUMBER OF FLOORS

The number of floors above the main terminal is limited to 18 for office and hotels, and to 40 for residential buildings. This is because building zoning is not addressed by this expert system.

3. IMPLEMENTATION

The uppeak round trip time equations and their application are discussed in detail by Barney [6].

IMPLEMENTED MANUALLY OR USING A SPREADSHEET, THE HUMAN EXPERT WILL CALCULATE IN FIVE STEPS:

a. The total number of lift trips per five minutes required to achieve the interval, e.g. for a design criterion of 30 s interval, there will need to be 10 trips (300 / 10) per five minutes.

b. The required car size based on the required handling capacity and number of lift trips.

c. The round trip time based on the round trip time equations.

d. The number of lifts required to satisfy the interval criterion based on the calculated round trip.

e. If the resulting handling capacity is more than required, the car loading is reduced by a small amount iteratively, and round-trip time calculation repeated until the required handling capacity (also known as passenger demand) is equal to the calculated handling capacity.

The risk of implementing this approach in software is that a solution can be rejected unnecessarily at Step D. For example, if the number of lifts required is calculated as 4.05, five lifts would be selected by a software solving the requirement to select the minimum number of lifts which allow the configuration to satisfy the interval criterion. However, there is a strong possibility that if four lifts had been selected at Step D, after the iteration in Step E, the criterion would have been satisfied. The small increment over the integer value would be noticed and addressed by a human expert.

Thus, a different approach is needed in software. With software, the calculations are so fast that the round trip time of every possible number of lifts, rated load and rated speed may be considered, and the iterative process completed, without the possible rejection of a solution.

The expert system software starts with one 450kg car with a rated speed of 1.0 m/s and cycles up through the possible configurations until all criteria in Section 2 are satisfied. An alternative (probably faster) approach would be to use the HARint plane [10].

4. ADDITIONAL CONSIDERATIONS

WHEN SELECTING LIFT INSTALLATIONS, THERE ARE CONSIDERATIONS IN ADDITION TO TRAFFIC CALCULATIONS [5], FOR EXAMPLE:

a. An office building may require larger lifts to create a feeling of prestige, or to enable furniture and office partitions to be transported.

b. A residential or hotel building may require larger lifts to accommodate furniture, stretchers and coffins.

c. According to the operation of the building, there may be a requirement for separate goods lifts

d. Where availability of lift service is crucial, a minimum of two lifts may be required despite a single lift meeting the criteria.

There may be other commercial, architectural, and occupant considerations.

These above considerations could be included in the expert system, but would require further questions to be asked of the user and assumptions built into the software by applying additional rules.

This expert system is designed only to select the minimum solution meeting the selection criteria in section 2, requiring an experienced practitioner to address considerations beyond the traffic calculation.

An expert practitioner might also consider a simulation of the selected solution.

5. APPLICATIONS

5.1. EXPERT SYSTEM SOFTWARE

The expert system may be applied in local or on-line software. An example on-line interface is given in Figure 1. This example inputs for an 18 floor (above main entrance floor) building with a floor population of 60 persons, and an interfloor distance of 3.3 m.

The expert system reports the result: 6 lifts with rated load 1000 kg @ 2.5 m/s.

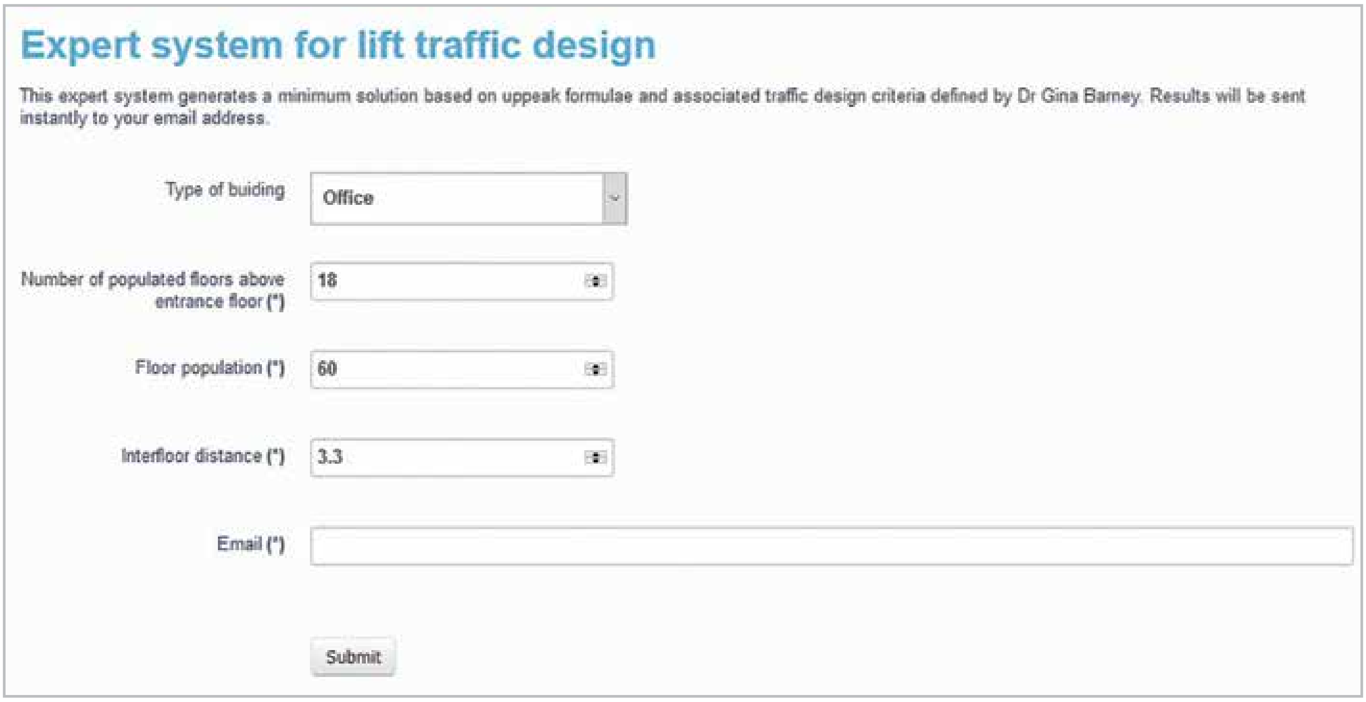

Figure 1 Example web interface to expert system

5.2. TABLES AND GRAPHS

For an offline interface appropriate to printed design guidance documents, results can be presented in tabular or graphic form.

THE TABULAR PRESENTATIONS IN [5] ARE FOR:

a. Office buildings up to 18 floors above the main terminal with interfloor heights 3.3 m, 3.6 m, 3.9 m and 4.2 m

b. Hotel buildings up to 18 floors with interfloor heights 3.3 m, 3.6 m, 3.9 m and 4.2 m

c. Residential buildings up to 40 floors with interfloor heights 2.5 m and 3.0 m

Figure 2 is an example for office buildings with interfloor distance 3.3 m generated by the expert system.

Note that for 18 floors above the entrance floor with a population of 100 persons per floor, the table reports “No solution meets criteria”. This is because eight of the largest lift cars that were considered by the expert system do not meet the design criteria.

Barney [11] proposes a graphical representation of results, see Figure 3. This is similar in approach to Ruokokoski and Siikonen [4] in that the limit of a lift configuration is plotted against population and number of floors. Barney uses lines rather than shaded regions which is less cluttered when more configurations are being considered.

For example, suppose a lift installation is to be selected for an office building with eight floors above the entrance floor and a population of 2000 persons. The circled result shows that there is a choice of either 8 x 1800 kg (which is about right) or 8 x 2000 kg (which provides extra capacity) or 7 x 2500 kg (which requires less lifts). Lift speed selection is assumed to follow Section 2.4.

Table A.2a Lift installation selection table for office buildings (d_f=3.3 m)

Number of populated floors above entrance floor	Floor population									
	10	20	30	40	50	60	70	80	90	100
1	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s
2	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s
3	1 450 kg @ 1.0 m/s	1 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s
4	1 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s
5	1 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 630 kg @ 1.0 m/s
6	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 630 kg @ 1.0 m/s	3 800 kg @ 1.0 m/s	4 630 kg @ 1.0 m/s
7	2 450 kg @ 1.0 m/s	2 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 630 kg @ 1.0 m/s	4 450 kg @ 1.0 m/s	4 630 kg @ 1.0 m/s	4 630 kg @ 1.0 m/s	4 800 kg @ 1.0 m/s
8	2 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 630 kg @ 1.0 m/s	4 450 kg @ 1.0 m/s	4 630 kg @ 1.0 m/s	4 800 kg @ 1.0 m/s	4 1000 kg @ 1.0 m/s	5 800 kg @ 1.0 m/s
9	2 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	3 450 kg @ 1.0 m/s	4 450 kg @ 1.0 m/s	4 450 kg @ 1.0 m/s	4 630 kg @ 1.0 m/s	4 1000 kg @ 1.0 m/s	5 800 kg @ 1.0 m/s	5 1000 kg @ 1.0 m/s	5 1275 kg @ 1.0 m/s
10	2 450 kg @ 1.6 m/s	3 450 kg @ 1.6 m/s	3 450 kg @ 1.6 m/s	3 630 kg @ 1.6 m/s	4 450 kg @ 1.6 m/s	4 630 kg @ 1.6 m/s	4 1000 kg @ 1.6 m/s	5 800 kg @ 1.6 m/s	5 1000 kg @ 1.6 m/s	5 1600 kg @ 1.6 m/s
11	2 450 kg @ 1.6 m/s	3 450 kg @ 1.6 m/s	3 450 kg @ 1.6 m/s	4 450 kg @ 1.6 m/s	4 630 kg @ 1.6 m/s	4 1000 kg @ 1.6 m/s	5 800 kg @ 1.6 m/s	5 1275 kg @ 1.6 m/s	5 1600 kg @ 1.6 m/s	5 1800 kg @ 1.6 m/s
12	2 450 kg @ 1.6 m/s	3 450 kg @ 1.6 m/s	4 450 kg @ 1.6 m/s	4 450 kg @ 1.6 m/s	4 800 kg @ 1.6 m/s	5 800 kg @ 1.6 m/s	5 1000 kg @ 1.6 m/s	5 1600 kg @ 1.6 m/s	6 1275 kg @ 1.6 m/s	6 1600 kg @ 1.6 m/s
13	2 450 kg @ 1.6 m/s	3 450 kg @ 1.6 m/s	4 450 kg @ 1.6 m/s	4 630 kg @ 1.6 m/s	5 630 kg @ 1.6 m/s	5 1000 kg @ 1.6 m/s	5 1600 kg @ 1.6 m/s	6 1275 kg @ 1.6 m/s	6 1600 kg @ 1.6 m/s	6 2500 kg @ 1.6 m/s
14	3 450 kg @ 1.6 m/s	3 450 kg @ 1.6 m/s	4 450 kg @ 1.6 m/s	4 800 kg @ 1.6 m/s	5 800 kg @ 1.6 m/s	5 1600 kg @ 1.6 m/s	6 1275 kg @ 1.6 m/s	6 1600 kg @ 1.6 m/s	6 2500 kg @ 1.6 m/s	7 2000 kg @ 1.6 m/s
15	2 450 kg @ 2.5 m/s	3 450 kg @ 2.5 m/s	4 450 kg @ 2.5 m/s	4 800 kg @ 2.5 m/s	5 800 kg @ 2.5 m/s	5 1275 kg @ 2.5 m/s	6 1275 kg @ 2.5 m/s	6 1600 kg @ 2.5 m/s	6 2500 kg @ 2.5 m/s	7 2000 kg @ 2.5 m/s
16	2 450 kg @ 2.5 m/s	3 450 kg @ 2.5 m/s	4 450 kg @ 2.5 m/s	4 1000 kg @ 2.5 m/s	5 1000 kg @ 2.5 m/s	6 1000 kg @ 2.5 m/s	6 1600 kg @ 2.5 m/s	6 2000 kg @ 2.5 m/s	7 1800 kg @ 2.5 m/s	7 2500 kg @ 2.5 m/s
17	3 450 kg @ 2.5 m/s	3 450 kg @ 2.5 m/s	4 630 kg @ 2.5 m/s	5 630 kg @ 2.5 m/s	5 1275 kg @ 2.5 m/s	6 1275 kg @ 2.5 m/s	6 1800 kg @ 2.5 m/s	7 1800 kg @ 2.5 m/s	7 2500 kg @ 2.5 m/s	8 2500 kg @ 2.5 m/s
18	3 450 kg @ 2.5 m/s	4 450 kg @ 2.5 m/s	4 630 kg @ 2.5 m/s	5 800 kg @ 2.5 m/s	6 1000 kg @ 2.5 m/s	6 1600 kg @ 2.5 m/s	7 1600 kg @ 2.5 m/s	7 2500 kg @ 2.5 m/s	8 2000 kg @ 2.5 m/s	No solution meets criteria

Notation 5 1275 means 5 lifts with rated load 1275 kg.

Figure 2 Example tabular presentation of results for expert system from [5]

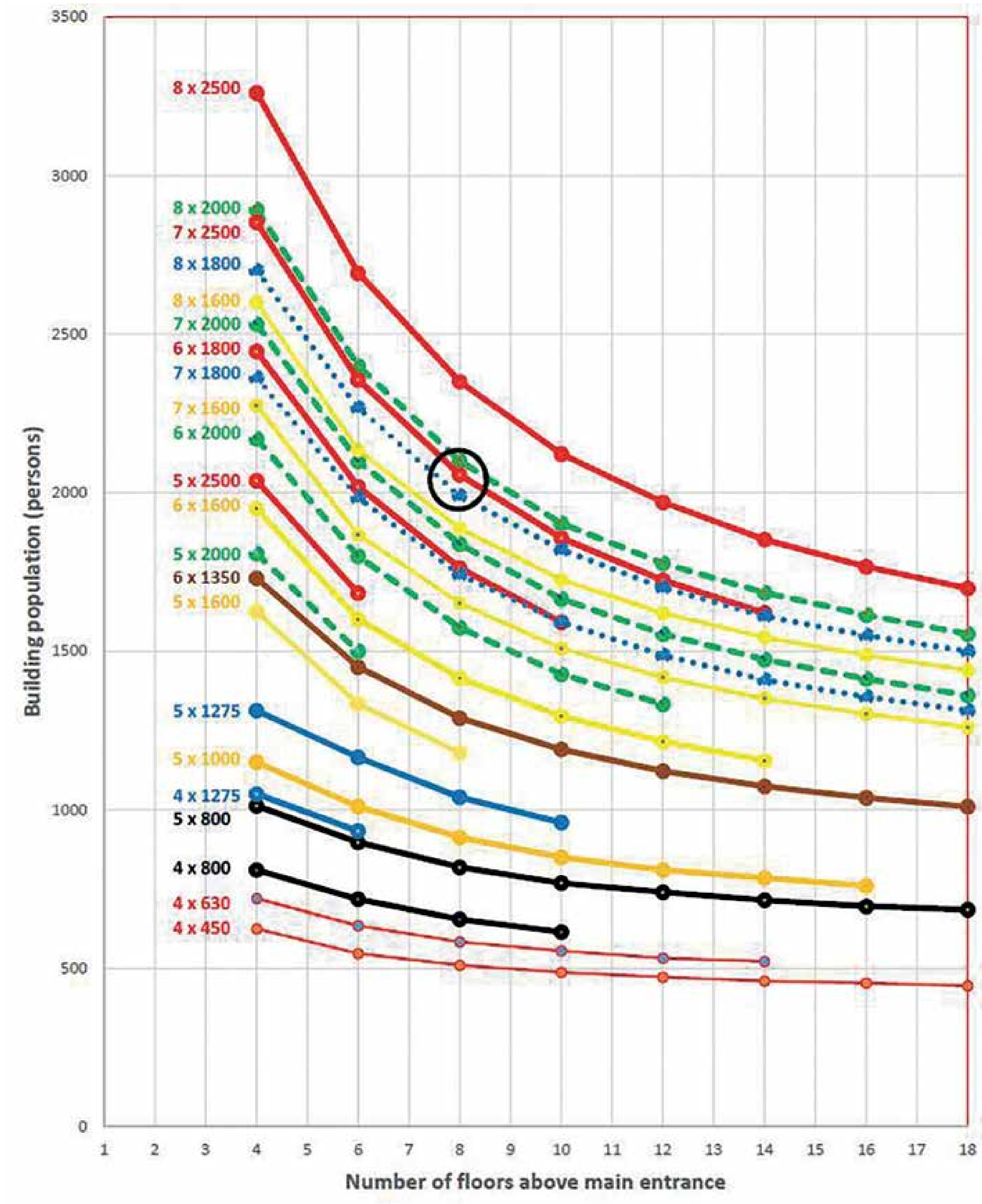

Figure 3 Example graphical presentation of expert system results proposed by Barney [11]

6. CONCLUSIONS

Expert systems for lift traffic design are feasible, but they are only as knowledgeable and as expert as the rules and data sets on which they are based.

The creation of charts and tables for quick selection has a long history [12]. Over the years many charts, tables and software algorithms have been produced, of varying provenance and transparency.

In this paper the authors have introduced and described an expert system implementing the uppeak design procedure applying data sets and rules provided by a respected expert. The flexibility of the expert on some design parameters has been expressed with a tolerance; an alternative to investigate in the future is the application of fuzzy rules [13].

Limitations of the expert system and how it could be extended have been discussed. Given this foundation, expanding the expert system for more complex scenarios and other analysis techniques, including simulation can be added.

De-skilling engineers by developing expert systems has technical risks. In the foreseeable future, not every scenario or exception will be anticipated by software developers and the human experts they consult. Thus, transparency of the data set and rules applied by any expert system for lift traffic design need to be reviewed and understood by an experienced practitioner before the results are applied.

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BIOGRAPHICAL DETAILS

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.

Sam Dean is a Software Engineer with Peters Research Ltd. He is part of the team working on enhancements to Elevate and related software projects. He is the lead developer behind the databases and servers managed by Peters Research.

LETTER FROM AMERICA

Artificial Intelligence and the Lift Industry

It is virtually impossible to watch a news program and not hear something about Artificial Intelligence (AI) and how it will affect all our lives. This is particularly true if you are watching a financial news channel.

Recently there has been a lot of news about the incredible financial successes of a Silicon Valley chipmaker, Nvidia, and their Graphic Processing Units (GPU).

It is important to understand how AI, GPUs, and Nvidia are going to affect the lift industry.

There are many forms of AI. However, there are two fields of AI that can benefit from the use of GPUs: Machine Vision and Artificial Neural Networks (ANN). Nvidia is considered to be the leading producer of GPUs for industrial, non-PC and AI applications.

A GPU is a computer chip that has been developed to process graphic data. When most people think of graphics processing, they usually think of computer gaming or CAD (Computer Aided Design). Those are exactly the markets for which GPUs were designed. California-based Nvidia, founded in 1993, started developing chips for the gaming market.

At some point it was discovered that GPUs were hundreds of times faster than CPUs at processing the complex algorithms used in AI. This is particularly true of Artificial Neural Networks.

ANNs use artificial neurons that function in a manner like the neurons in our brains. ANNs can be trained to recognize images. The word image suggests graphics.

An example found in Wikipedia is the training of an ANN to recognize a cat by showing the ANN a series of images that contain cats that are labelled CAT and images without cats that are labelled NO CAT. The ANN does not need to know anything about cats. They only classify images that have a cat in them as CAT and images without a cat as NO CAT.

ANNs can be trained to recognize lifts with properly adjusted door operator belts and lifts that have loose belts that need to be tightened.

They do this not with cameras, but with accelerometers. An accelerometer mounted on a lift car can create a ride quality vibration ride pattern. This is easily done with a Ride Quality Analyzer.

A sophisticated accelerometer mounted on a lift car can also generate a vibration pattern of lift door operation. An accelerometer chip for this type of application typically costs less than one pound (£1).

The door vibration pattern, using some complex math, can convert this pattern into an **image**. The ANN can be trained using images labelled Proper Belt or Loose Belt.

Acoustic patterns generated by microphones can also be converted to images using similar methods.

Imagine a lift equipped with microphones and accelerometers, a GPU, and a cellular modem connected to the cloud requesting a technician be sent to the site to fix a problem before anyone onsite knows they have a problem.

HOW WILL THIS AFFECT OUR INDUSTRY?

We should be able to improve customer satisfaction and at the same time improve our operational efficiency.

HOW LONG WILL IT BE BEFORE A LIFT WITH A GPU AND AN ACCELEROMETER IS AVAILABLE?

I would be surprized if such lifts were not already under development.

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

Joining us today at the Leadenhall Building in London is Omar Marfoua, Specialist Lifts & Services Manager at Shorts. A true London landmark, the building is informally referred to as the 'Cheesegrater', due to its wedge shape. It boasts the world's largest and fastest suite of panoramic lifts, and with 45 storeys, we're in for some spectacular views across the River Thames and beyond.

DOORS CLOSING, GOING UP...

CAN YOU BRIEFLY DESCRIBE YOUR ROLE FOR US?

Shorts only supplies to the lift industry, designing and making bespoke lifts for clients.

We manufacture lifts on behalf of other lift companies, delivering and installing the products to supply a fully functioning, tailormade lift. Day to day, I design concepts, manage the process, liaising with clients, specifiers and architects, through to installation.

YOU'VE BEEN WITH SHORTS FOR OVER 30 YEARS, WHAT'S KEPT YOU THERE?

I don't know! I've worked for three generations of owners – grandfather, father and now the third generation. You could say I'm part of the family!

WHAT DO YOU ENJOY MOST ABOUT YOUR JOB?

I love that every day is different, it's not monotonous, I have no idea what I'll be doing, day to day. Our clients have such unique requests that I never know what will be next.

DO YOU HAVE A FAVOURITE PROJECT FROM THE LAST 30 YEARS?

About six years ago, we did a project for the media company, Bloomberg.

Figs grown from a tiny plant from Omar's Sahara home

They discovered Roman ruins as they were building. As they weren't allowed to dig where the ruins were, they had to change the shape of the whole building and this meant they couldn't dig a pit for one of their lifts. Kone were supplying their lifts and called us with the problem. We didn't have anything that would solve this, but on a business trip I mentioned the issue to a contact who recommended someone who had been out of the lift business. He fortunately had returned to the industry and together we were able to design and supply exactly what the customer needed. It was the first in the UK and we now specialise in these kinds of lifts for major projects, mainly for bike lifts now.

We also have a product called the 'under-bar' lift. That request came from someone budling a yacht. They wanted a lift to come to the top deck, just to bring champagne. There's not a lot of height, so we designed a lift where the top came to just under the worktop, hence the 'under-bar' lift. We had to design it specially for the yacht with all the requirements of a boat, of course. That was a unique project!

WHAT ARE YOU WORKING ON AT THE MOMENT?

I can't talk too much about it, but we are working on a project in the Houses of Parliament. We've also finished specifying / designing some special lifts for the Ritz. There's always something on our plate!

OUTSIDE OF WORK, WHAT DO YOU ENJOY DOING?

I used to do a lot of swimming and football, but I've been converted to gardening and cooking now. I'm growing the odd tomato, but mainly flowers, and I'd cook you a great seafood meal.

IF YOU WERE GOING TO ORDER TAKEOUT TONIGHT, WHAT WOULD YOU CHOOSE?

It would have to be pizza. No pineapple, no ham, just tomato sauce.

IF I GAVE YOU A ONE-WAY TICKET TO ANYWHERE IN THE WORLD, WHERE WOULD YOU CHOOSE TO LIVE, ASIDE FROM HERE, OF COURSE!

Sahara Desert – that's where I'm from!

WHAT NEVER FAILS TO MAKE YOU LAUGH?

Fawlty Towers.

IF YOU HAD TO CHOOSE YOUR FAVOURITE LIFT, ANYWHERE IN THE WORLD, WHICH ONE WOULD IT BE?

Here at the Cheesegrater in London – the bank of lifts here is spectacular. The concept, the engineering and the architecture – it's all just fascinating.

We absolutely agree! Thank you to Omar for sharing his story, it's been so interesting learning more about him and some of the projects he's been involved with.

You can find out more about Shorts and their bespoke lift design at *www.shorts-lifts.co.uk*.

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.

DEAR JOHN

I am a Building Manager for a large public entertainment company. Last year we had three heavy rubber mats delivered directly to our building courtesy of our lift maintenance company. The mats remain rolled up in the position we placed them as advised by the lift maintenance companies operative. We paid almost £500.00 and I am at a loss to wonder what they are meant to do. Please advise.

Mark B
London

JOHN SAYS

Thanks for bringing this issue to our pages. First of all, I would advise that you speak directly to your maintenance company and tell them to deploy the mats correctly as soon as possible. They are intended to provide an insulated platform in front of the lift control panels.

The lift industry is fortunate enough to have a standard which is specifically written to protect and enhance the safety of operatives working on or around lifts BS7255 Code of Practice for Safe Working on Lifts. Annex D2 of the document gives guidance on working on live electrical equipment which refers to the use of rubber mats to form an isolation platform which can significantly reduce the risk of severe electric shock. The mats should meet the requirement of BS EN61111 (the old BS921 standard has been withdrawn).

In theory the mat should be placed in front of the lift control panel to provide an insulated space for engineers working on live equipment. In practice and in my experience we see them placed anywhere but in front of the control panel.

The pit is not an uncommon place to find the mat still rolled up from the original installation. This is not only potentially compromising safety and compliance it's also very poor housekeeping.

On a positive note, I recently surveyed a modernised MRL lift in Manchester which the contractor had taken time out to line the top of the car out in 6mm rubber matting along with providing a safe area in front of the maintenance and control panel on the landing. A great effort at very low cost.

With the high voltage drive and machine mounted in the shaft this should be a standard feature in my opinion.

With the revision of BS7255 likely to be with us soon, surely we, as an industry, can make an effort to cease the practice of simply delivering rubber mats and start to deploy them correctly.

Happy to answer any further questions on this topic.

JB

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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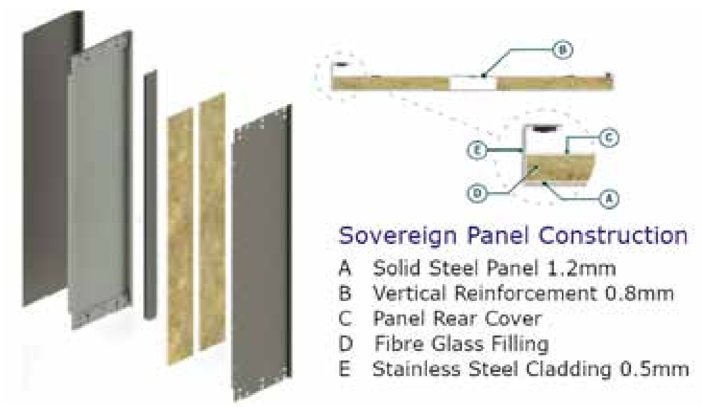

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