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A Multidisciplinary Knowledge Transfer Partnership in Development of Lift Simulator

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Lift Traffic Studies are done on “Peak Traffic”

Offices – One way traffic or morning “up peak”
Hotels – Two way traffic or “evening peak”
Residential - Two way traffic “evening peak” or “morning down peak”

Lift Traffic Studies

Three busiest times of the day for lifts in offices

- Morning “up peak”
- Lunchtime “two way”
- Evening “down peak”

Traffic Studies for Offices

- Morning is normally the busiest time for lifts
- “Up Peak” – people arrive at building main floor
- 25-30 minute period covers the majority of arrivals
- Local transport Infrastructure?
- Single or multi tenant?
- City Centre?

Traffic Studies

Performance Criteria

- Quality of Service
  How long we have to wait for a lift to arrive

- Quantity of Service
  How many people can be moved by the lifts in a given time (5mins)

Traffic Studies for Offices

- "**Quality" of Service** Establish theoretical average interval (the time in seconds between consecutive lift departures from the main floor during the peak "5-minute" period). Typically;

  Excellent = < 20 seconds

  Very Good = 21~25 seconds

  Good = 26~30 Seconds

  Poor = >30 seconds

Traffic Studies for Offices

- **Quantity of Service**

  Establish theoretical “5-minute handling capacity” for the building for morning “up peak” traffic. Typically;

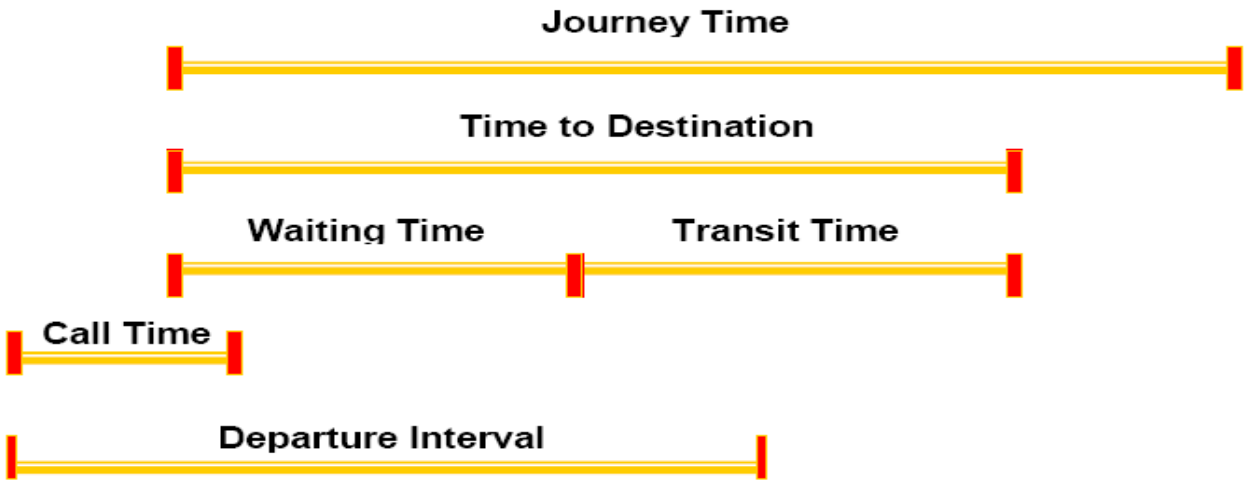
  12% per 5 minutes for multi tenancy

  15~17% for single tenancy

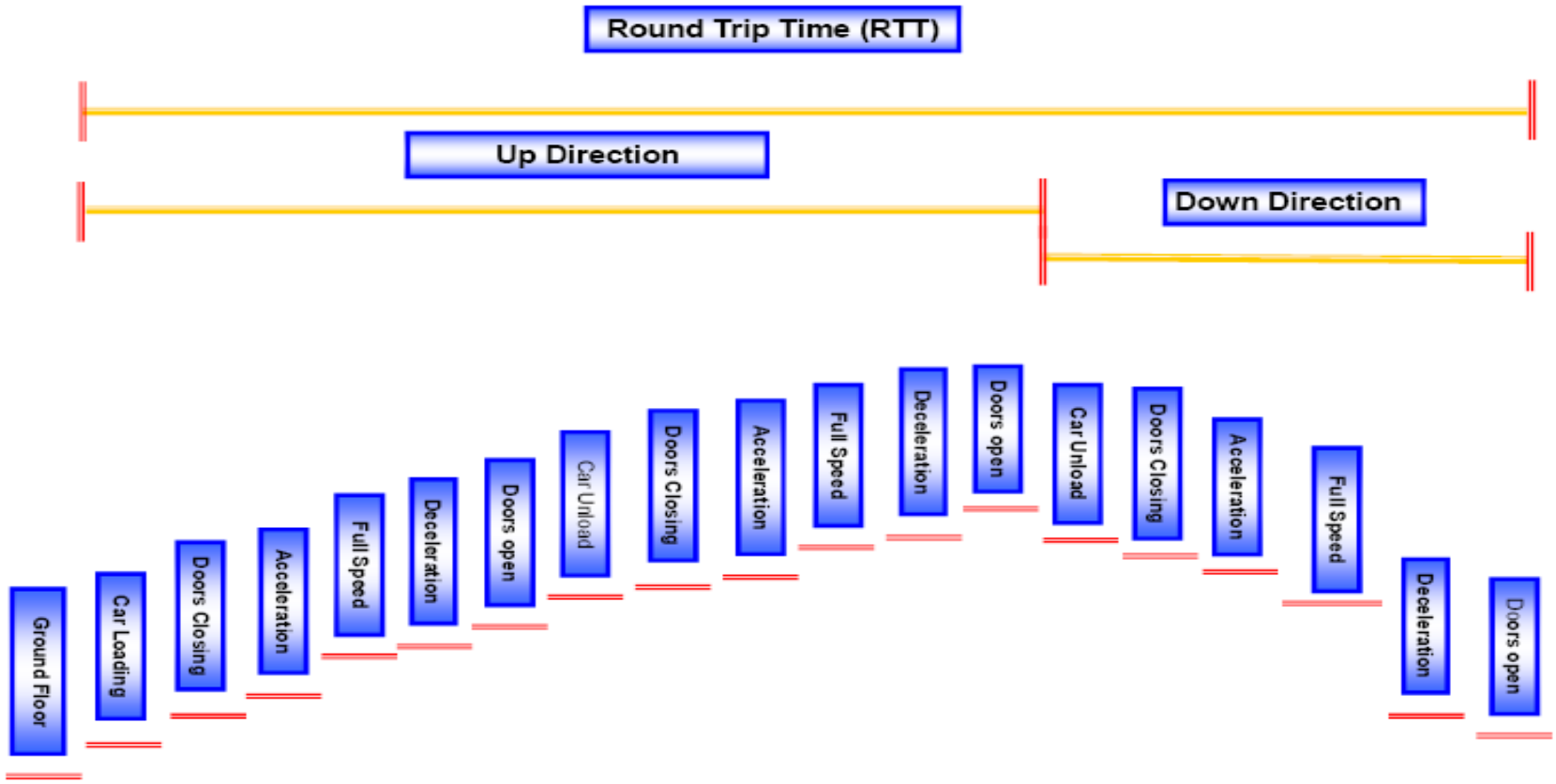
  The “quality of service” is judged by reference to the same 5-minute “up peak” period

Lift Traffic Studies

Terminology



Lift Traffic Studies



Around 2000 it became feasible to start and portray lift systems visually to give clients and architects a more direct understanding of the likely performance of the lift services. Telling the developer that 11% 5-minute handling capacity would represent “poor” lift service was nothing compared to seeing people queuing outside the building to get into it!

Such visual simulations were “job specific” and very expensive, this one cost over £20,000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In 2007 Lerch Bates approached Kingston University with an ambitious project. In summary we wanted an all-in-one system to deliver calculation, simulation, 3-D visualisation and an architectural building information model all to be delivered as output files.

In 2009 we are making considerable progress and here is a short insight into that work....

Simulation Structure

- The dynamic simulation of the lift system originally was developed in Matlab/Simulink
- The simulation model consisted of four main parts:
  - Passenger generation
  - Car jump
  - Individual car controller
  - Group controller
- After initial testing and validation the simulation model has been translated into C language

Group Control Algorithm

Two types of group control are considered:

Conventional (Directional) hall calls and

Destination hall calls.

Software Development Structure

The application is developed as four distinct sub-systems: *Calculation*, *Simulation*, *Visualisation* and *Reports*, which can be selected independently and which are linked together via a user front end.

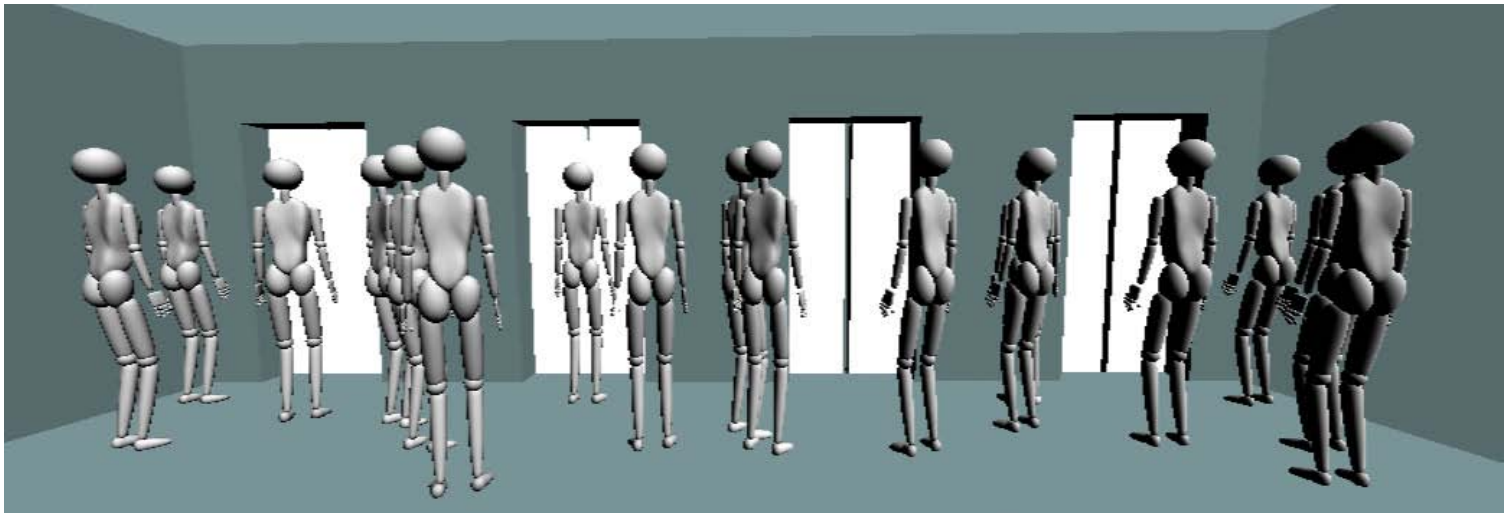
3D Drawing Information & Visualisation

Our application constructs a Building for the essential 3D structure of the lift shafts, machine rooms, lift pits and landing lift lobbies and exports it applying IFC – the Industry Foundation Class.

This model is built using either data directly involved in the simulation process or automatically derived from the specification of the lift system chosen by the user, with most parameters exposed for further manual tuning.

Visualisation

The visualisation module renders the building structure and populates it with 3D animated human characters. They are driven by the simulation subsystem outcome.



Conclusions

- There is a need for more advanced lift simulation applications, ideally linking to the building design software
- The development of a simulation tool has been presented, based on stochastic passenger generation, dynamic lift model and control algorithms for optimisation of lift systems
- The simulation is connected to the visualisation software (for passenger movements) and to 3D building design software

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Main Benefits - Lerch Bates

- *Market position and reputation.* Ever more ambitious construction projects that utilise ongoing advances in civil engineering will require an understanding of the entire people moving system.
- *Improved efficiency / profitability.* The system will enable engineers to efficiently design, specify and model options.
- *Increased turnover / growth.* The system will increase the efficiency of the existing LB workforce.

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Main Benefit - KTP Associate

- A Professional Development Plan is put in place for each associate, highlighting strengths weaknesses and areas for improvement through training.
- Each associate is encouraged to complete a degree during their associateship and it is one of the main reasons that people become KTP associates.
- The degrees are based on the work being done and are supervised by the university – Work Based Learning.
- The Associates are encouraged to attend professional / scientific conferences.