What does “space” mean to a services engineer?
Money

- Oversizing by 10% can cost £1,000,000s in lost rent for a prime location office
- Providing an 10% additional space can cost £10,000s in build costs

Source: Knight Frank
prime office rent (£ per sq ft pa)
Coordination

• Design time penalties can arise from having to coordinate too much equipment in too little space
• Increasing complexity could add 5-10% to design costs – enough to turn a profit maker into a loss maker
Installation

- Insufficient space can cause installation issues (e.g., coordination, health and safety) leading to delays, possibly claims
Maintenance

- Inadequate access provision can also result in poor maintenance leading to reduced life of plant, reduced energy efficiency and increased risk of failures
Access

- Inadequate access provisions for plant maintenance and replacement can mean costly and/or disruptive special access provisions are required further down the line.
Health and Safety

- Legislation underpins the provision of adequate space in buildings, in particular the Health and Safety at Work Act plus associated regulations including:
  - Management of Health and Safety
  - Workplace (Health, Safety and Welfare)
  - Provision and Use of Work Equipment
  - Construction (Design and Management)
  - Manual Handling Operations
  - Electricity at Work
  - Pressure Systems and Transportable Gas Containers
- Building Regulations Part B Fire Safety includes requirements with regard to escape provisions
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Source: IEE Wiring Regulations (17th Edition), Amendment No.1 Section 729 – Operating or Maintenance Gangways
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Table 2 Limitations on travel distance

<table>
<thead>
<tr>
<th>Purpose group</th>
<th>Use of the premises or part of the premises</th>
<th>Maximum travel distance (d) where it is possible in one direction (m)</th>
<th>More than one direction (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional</td>
<td>9</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Other residence, a. bedroom</td>
<td>6</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. bedroom corridor</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>overall</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td>Shop and commercial</td>
<td>16</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>Assembly and recreation, a. buildings primarily for disabled people</td>
<td>6</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. areas with seating in rows</td>
<td>16</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>c. elsewhere</td>
<td>16</td>
<td>46</td>
</tr>
<tr>
<td>Industrial</td>
<td>Normal Hazard</td>
<td>26</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Higher Hazard</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>Storage and other non-residential</td>
<td>Normal Hazard</td>
<td>26</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Higher Hazard</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>Place of special fire hazard</td>
<td>0 (\times ) 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient room or waiting room</td>
<td>a. distance within the room</td>
<td>16</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>b. escape route (not open air) overall travel distance</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>c. escape route (open air) overall travel distance</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

Notes:
1. The distances in the Table are travel distances, if the internal layout of partitions, fittings, etc. is not known what plans are described, direct distances may be used for assessment. The direct distance is taken as 20% of the travel distance.
2. Measure part of the travel distance within the room, or the travel distance within the bedroom and any associated dressing room, bathroom or sitting room, etc., and is measured to the door or protected corridor serving the room or suite. Sub-Rom (b) applies from that point along the corridor outside to a lobby or entrance.
3. Maximum travel distance while shopping shall be given in BS 5974 Part 10. Guidance on associated smoke control measures is given in BS 5588 Part 2.
4. BS 5974 Part 10 applies more restrictive provisions to exits with cover less than 15 meters covered shopping complexes.
5. In buildings the appropriate travel distance imposes on the level of the hazard associated with the process and materials being used, a higher hazard includes manufacturing, processing, or storage of significant quantities of hazardous goods or materials, including any compressed, liquefied, or dissolved gas, any explosive which becomes dangerous by interaction with water, a flammable or other explosive, any corrosive substance, any oxidizing agent, any substance liable to spontaneous combustion, any substance which changes or decomposes readily giving off heat when doing so, any combustible solids substance with a flash point less than 100° Celsius, any substance liable to spread fire by flowing from one part of the building to another.
6. Flash point of the first hazard listed in the definitions in Appendix E.
7. Maximum part of travel distance within the room, or the travel distance outside the room with the limits for the purpose group of fire building or part.

Source: Building Regulations 2010 Part B Fire Safety Volume 2
Energy

- Energy consumption may be reduced by providing space eg:
  - for air flows to avoid starvation / short-circuiting
  - to avoid constricted / contorted distribution routing
  - to install more efficient equipment and low carbon technologies
Future Provision

- Space may be required in future eg:
  - for fit out equipment
  - to provide for future flexibility and adaptability in building use
  - to cater for the impact of climate change on loads and equipment performance
  - to integrate low carbon technologies as their economic viability improves
Calculating Requirements - Traditional

- To do calculations accurately by traditional means can take a significant amount of design time.
- The calculations can be subject to design changes if done too early costing design time for repeat calculations.
- However, doing calculations later in the process can also cost design time and cause disruption if significant changes to floor plans etc are required to accommodate the space required.

Source: CIBSE Guide M
Calculating Requirements - Software Automation

- Software offers the opportunity to reduce the calculation time required by automating parts of the process
- Calculations can be done early in the design process as the cost of repeat calculations is minimal
Calculating Requirements - Process

- Establish the brief including required functionality, system types, design criteria, etc
- Calculate of loads and duties (rules of thumb, spreadsheets, early models)
- Determine equipment requirements, locations, groupings
- Select and size equipment
- Layout equipment incorporating maintenance clearances, air intake clearances, access requirements, etc
- Generate outputs

Increasing time, repetition
Reducing interactions, constraints

=> Automation should focus on the backend tasks
Automating Layouts – Template Solutions

- Use templates to define typical solutions which are appropriate to or at least good starting points for majority of applications

![Diagram of Space Allowances Software: Select template and set key variables]
Automating Layouts – Template Solutions

- Use templates to define typical solutions which are appropriate to or at least good starting point for majority of applications
- Enable users to add / remove equipment for flexibility
Automating Layouts – Rules

- Use rules to automate selection and sizing of equipment
Automating Layouts – Rules

- Use rules to automate selection and sizing of equipment
- Enable user inputs to provide flexibility
Automating Layouts – Generic Equipment

• Select equipment from each of the manufacturer ranges
• Size generic equipment using worst case width, depth, height and maintenance dimensions
Automating Layouts – Generic Equipment

- Select equipment from each of the manufacturer ranges
- Size generic equipment using worst case width, depth, height and maintenance dimensions
- Enable users to define their own equipment to cater for bespoke items
Automating Layouts - Location

- Automate location taking into account maintenance clearances, air flow space, access routes, etc
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Automating Layouts - Location

- Automate location taking into account maintenance clearances, air flow space, access routes, etc
- Enable users to drag, rotate equipment etc to fine tune layouts
Automating Layouts - Outputs

- Information and style should be appropriate to design stage
- Add information where it will assist decision making process
- Format should allow user editing (Word, CAD)
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- Information and style should be appropriate to design stage
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Automating Layouts - Lessons

- Automation is suited to processes with a high degree of time consuming repetitive tasks which have limited interactions / constraints and practical variations
- Reducing the scope of the solution may increase suitability by reducing the number of variations and interactions
- Partially automated solutions can be of significant benefit for some applications, eg user routing with automated sizing of distribution services
- User interaction with the process should be provided so the user has ultimate control over the process
- The designs generated should act as templates that can subsequently be edited / adapted to suit different project requirements
Automating Layouts – Space Allowances Software

- Please use the following link to view a short demonstration of software to automate design layouts [www.lowcarboncomfort.com](http://www.lowcarboncomfort.com)