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## A Review of Dynamic Directional Exit Signage: Challenges & Perspectives

For decades, the NFPA and ICC model codes have required an occupancy, having two or more required exits or exit accesses, to be provided with illuminated signs that readily identify the location of and indicate the path of travel to the exits. The UL 924 Standard specifies how static exit signs are to be designed and manufactured. The model codes and product standards require that the signs must be illuminated with letters reading “Exit.”

The static Exit sign messaging has served the general public well, in the past, for fire emergencies and for buildings with simple egress layouts. However, in buildings with more complicated egress layouts, there may be opportunities for dynamic signage. Additionally, in recent years there are other emergencies for the public to deal with such as active shooter events that require people to move rapidly to areas other than the typical exit. This is particularly true for buildings with complicated egress layouts.

Technological advances in sensors, controls, and artificial intelligence algorithms are being designed into emergency lighting systems to allow them to adjust to changing building circumstances. Dynamic directional signage that can change the displayed information based on real-time conditions presents a series of tradeoffs. The potential benefit of a changing message sign would be to deter occupants from a direction of travel that may be blocked or otherwise unavailable due to adverse conditions such as fire, structural collapse, active shooter or other unsafe conditions that may warrant avoidance.

### Project Goal & Approach

The goal of this project was to identify the use and regulation of dynamic directional emergency exit signage or lighting and its impact on occupant evacuation, through a literature review.

### Summary Observations

Unlike the static nature of conventional exit signs, a dynamic exit sign is more conspicuous and adaptive to rapidly changing fire scenes inside complex built environments. Dynamic exit signs must integrate some dynamic features while still satisfying the requirements for conventional static exit signs. Unlike conventional static exit signs, dynamic exit signs are not just stand-alone devices but are part of an intelligent system. Such systems require a control system of a certain intelligence, sensors, and data communication and processing.

In general, there are two types of dynamic exit signs—fixed dynamic exit signs and adaptive dynamic exit signs. A fixed dynamic exit sign emphasizes information. Whereas an adaptive dynamic sign is more advanced and intelligent as it uses persuasive and dissuasive signals in response to a centralized system to provide additional information, such as warnings of potential dangers or upcoming detours. A hierarchy for dynamic exit sign systems of different intelligence levels and at varying technology milestones is proposed as:

- Level 1: Flashing lights on Exit Sign
- Level 2: Persuasive and Dissuasive Design
- Level 3: Intelligent Digital Twin Integration
- Level 4: Advanced Human-Computer Interaction

Studies have shown that the flashing feature of dynamic exit signs provides greater conspicuousness to occupants in fire emergencies and more efficiently facilitates the evacuation process. However, a centralized intelligent system is required to control adaptive dynamic exit signs and indicate escape routes in a real-time building environment.

It must be acknowledged, however, that dynamic exit signage systems are still a new concept both in industry and academia, and its development is still in preliminary stages. Before dynamic exit signage systems are officially used, more research is needed to enhance code development, technology application, and knowledge exploration, including, continuing the investigation of human behavior, implementing real-life experiments, and introducing emerging technologies.

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