The Faults with Default

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INTRODUCTION

Any computer model is merely a representation of reality that involves a combination of the model's representation of current theory, user's knowledge, and engineering judgment. When employing sophisticated simulation tools, the user is required to provide input data to the model, select between embedded data-sets, select between scenario or behavioral settings, and/or rely on hardwired data. Depending on the model, the user is frequently tasked with providing information on occupant response (movement and behavior) that allows the simulation tool to operate and results to be generated. This requires a significant amount of expertise on the part of the model user and during model development. Critically, it requires an understanding of the implications of using and employing this data.

This paper discusses model defaults, their use, and the consequences of their use on engineering results. A default setting is an initial setting provided by a developer that enables the model to be used without the modification of model settings and/or the provision of new data. Defaults are often provided as shortcuts to configuring an evacuation model because they allow the user to run the model and familiarize themselves with the model's functionality without understanding all of the model's capabilities. In reality, the vast majority of software programs (including engineering models) require defaults to prevent the model from initially being difficult to use and to provide some guidance on parameter selections. This is reasonable and expected. However, in scientific or engineering models, the selection (and the associated description) of the default settings can have a significant impact on the results produced. This is particularly the case in a relatively immature field(s) such as egress modeling and human behavior in fire.

There are both positive and negative aspects of providing defaults in current evacuation models. Default values or parameters can prove useful in the simulation of certain (basic) scenarios that are commonplace and/or similar to those from which the default data/understanding was collected [1,2], especially given the lack of an overarching theory. Conversely, the use of default values or parameters can provide the user with ready-made input that may not be relevant to the scenario being modeled and/or provide a ready-made scenario that precludes the user from understanding the input and the results produced.

MODEL EVOLUTION AND COMPLEXITY

The rapid increase in computer capabilities and the decrease in cost have expanded the use of computer models in all fields of engineering. This is also true of egress modeling where the rapid availability of technology, changing regulations and increased awareness have led to numerous models becoming available over a short period of time [3]. Often, the sophistication employed within the models supersedes the underlying theory, the data available, and the expertise and experience of the user[1]. Default settings then become necessary both to enable the model to function and, occasionally, to fill in the gaps.

Developers are consistently creating and updating current evacuation models to simulate and visualize larger and more complex structures. These models have different levels of scope, sophistication and refinement, and employ a range of different techniques [2-17]. In addition, the manner in which the user interacts with the model and manipulates model parameters/settings will depend on the nature and complexity of the model interface; for instance, whether the interface is text-based or windows-based,

whether the model settings are logically or haphazardly presented, or whether the model has limited or numerous settings and opportunities to provide data. Given that the model interfaces are non-uniform (between each other or over time) the manner in which data can be supplied and model settings manipulated may vary greatly.

DEFAULT COMPLEXITY

Just as evacuation models range in complexity, so do the default values or settings that models employ. Default settings vary across evacuation models in the following ways: the transparency of defaults included in the model, the range of model parameters within the evacuation scenario addressed by the defaults, the scenario represented by the default settings and the impact of the defaults on the evacuation results.

Default settings are reasonably apparent in simple models – where there are relatively few settings to configure. As models get more complex, the location and manipulation of settings becomes more convoluted. Therefore, it becomes more difficult to establish what the defaults settings are and what the group of settings should be. Understanding of default settings is also made more difficult given that there is little agreement on terminology, quality of data/theory and how to represent these factors within a model.

Models have developed for a range of reasons and applications [17]. Given this, models are applied to a number of different environments, incident scenarios, populations and procedural responses. Some models are specifically designed to cope with a relatively narrow range of scenarios; for instance, based on theory and data to cope with maritime situations, domestic residences, high-level macroscopic analysis, etc. [12, 14] Others have a broader functionality requiring more intervention from the user to configure the model for a specific application [14]. As such, for some models, the default settings will address a narrow range of parameters specific to a certain area of analysis; in other models, the default settings may relate to a more general range of parameters that could apply to a range of different scenarios.

Last, it is also difficult to determine the impact of the defaults on the evacuation results produced by the model. However, the limited number of parameters employed within simple models (e.g., flow models) can also mean that a single setting is likely to have a more significant impact on the results produced. For instance, engineering calculations (a relatively simple model) may only have a small number of ‘settings’ to which the user has access; e.g., the underlying data-sets on which the functions are based. However, modifying these data-sets will have a huge impact on the results produced.

CATEGORIES OF DEFAULT SETTINGS

Evacuation models adopt several strategies regarding the use of default settings. These strategies relate to simplifying model configuration, informing model configuration, and encouraging conservative modeling (e.g., where the model developers deliberately employ conservative settings to prevent unrealistically efficient evacuation performance). These strategies are related to the nature of the model itself and the manner in which it was developed. Broadly these default strategies can be grouped in the following three categories:

Category A: No default settings – the model usually requires a full data-set(s) provided by the user prior to it being run. The model is initially not able to be run, but requires some effort on the part of the user to ‘complete’ the model, populate it with data and then configure it for the scenario(s) at hand. It therefore requires a great deal of technical and subject matter expertise from the user.

Category B: Default – a single ‘factory’ setting enables the model to be used on arrival. Given that the user has a rudimentary understanding of the model’s interface and model application, he/she is able to generate results. This requires a less sophisticated understanding of the fundamental structure of the model than Category A models, but an equivalent understanding of the subject matter involved.

Category C: Pre-Defined – the model has a base default setting, but also has a number of pre-defined settings or libraries. These are designed by the developers to suit a set of associated scenarios. These require selection and this selection automatically provides data/parameter settings within the model. The user requires an equivalent understanding to Category B models. The convenience of a set of libraries makes the model more convenient; however, it also requires that the user is able to accurately map the libraries to appropriate real-world scenarios of interest.

The provision and use of the default settings provided can influence the results produced. As a model is used for more complex scenarios, the expert user is less likely to completely rely on defaults, but to manipulate relevant settings of the model manually to better suit the scenario at hand. However, a less expert user may not necessarily understand the extent of the settings available in the model, the nature of the defaults provided, their suitability to the scenario being examined, and the impact that these settings may have on the results produced.

CONFIGURING MODELS AND POTENTIAL DEFAULTS

When engaged in the engineering practice of egress modeling, the user is required to configure five basic performance components to represent the model scenario(s) within the evacuation model [18]. For use in an engineering analysis, a computational tool or engineering calculation must, at least, be able to address these core components. Therefore, these components are often addressed in the model default settings. The five core components that represent evacuee performance are the following:

1) *Pre-Response Time* (or pre-evacuation time) – the time for evacuees to initiate movement to a place of safety once a cue has been received,
2) *Initial Speeds* – the speed at which evacuees can move in a given egress component once they initiate evacuation movement,
3) *Route Availability* – the routes available to the evacuating population to move from their current position to a place of safety,
4) *Route Usage* – the routes selected by the evacuating population to move from their current position to a place of safety,
5) *Flow Conditions / Constraints* – the relationship between speed, flow, population density, egress component, and population size assumed during the scenario.

There are certainly other components that influence evacuee performance that can have associated default settings; e.g., the manner in which a population is distributed about the space. However, these five components are considered the most common, and will be examined here.

The engineer is frequently tasked with configuring the pre-response time of the population, as input to the evacuation model. This is the amount of time that the occupants delay before beginning purposive movement to a place of safety. In reality, these times can vary greatly [16] and range from very quick responses (e.g., those in the room of origin) to a delayed response (e.g., population is asleep). Depending on the scenario, the user may assume an immediate response (the population responds immediately), a distributed response (the population responds within a pre-determined range), an observed response (the population responds according to a collected data-set), or allow the model to predict a response.

The engineer may be required to provide/select travel speeds for occupants. The nature of the user action differs greatly between models: some models ‘predict’ travel speeds with performance based on occupant characteristics, such as gender and age. Others apply data directly. Depending on the scenario, the user may assume that the population has a uniform speed , set a range of speeds, select a representative data-set, or allow the model to predict speeds according to pre-determined factors.

Also, the engineer may be required to specify the routes available to occupants and/or the routes that certain occupants select in order to move to a place of safety. Depending on the scenario, the route availability may be total (i.e., all routes are available), user-specified (i.e., the user manipulates route availability directly), or limited according to developing scenario conditions. Depending on the scenario, the route use may be based on proximity (i.e., nearest route), design (i.e., according to the expectation and code), familiarity (i.e., according to the routes familiar to the population), user-

defined (e.g., to represent a procedure), or predicted (e.g., adaptive route selection according to conditions).

Last, the user may need to provide flow conditions or constraints that govern the relationships between the achievable flow and population density conditions evident. Depending on the nature of the model, this may require the user to determine the relationship between flow and density directly, or associated constraining flow values to components (e.g., cap the maximum achievable specific flow associated with a door). To achieve this, the engineer will need to understand the types of crowding expected in the building during evacuation in each model scenario.

Many evacuation models provide default values and parameters that allow the user to accept predefined inputs/settings in order to simplify the configuration process or inform the manner in which they configure the model. Examples of default model settings provided for each of the five core components are shown in Table 1. These typical default settings for these five components form only a sub-set of the potential user selections that might be used to represent scenarios of interest (a selection of which were described above). Inevitably, this means that the reliance of a user upon the defaults provided may lead to some scenarios of interest being misrepresented.

Table 1: Defaults for core components[18].

Performance Component	Evacuee Response
Pre-Response Times	Immediate response Hypothetical distributed response Response from a particular dataset (imbedded into the model)
Initial Speeds	Uniform speed Distribution according to a particular dataset
Route Availability	All routes are available
Route Usage	Evacuees use nearest exit
Flow Characteristics	Flow levels derived from literature/datasets/code

SUGGESTED IMPROVEMENTS

Default settings are a useful tool for model developers to ensure that their models are more easily employed and cater for the most frequently employed scenarios. However, by their very nature, default settings are only able to cope with a sub-set of the scenarios to which the model will be applied. As the number of possible applications types expand and the range of expertise extends, so the discrepancy between potential and default settings (highlighted in the previous section) will become more apparent and potentially have a more serious impact. It is certainly not suggested that default settings be avoided. In many instances as well as being beneficial they may be unavoidable. However, there some basic actions that could reduce the default pitfalls highlighted without reducing the benefits of the default settings themselves:

- An acknowledgement that there is no such thing as a generally applicable default setting given the complexity of human response and the range of scenarios that can arise. This may be beyond the developer's control, although they can certainly emphasize this in supporting documentation. No default setting can be relied upon either to represent typical behavior, or necessarily lead to conservative results.
- The developers could clearly describe what the default settings are, where they are derived from, and why they were incorporated in the model.
- The developers could clearly describe the intended applications areas to which the model can reasonably be applied.
- The developers could develop an intuitive interface to aid in the understanding of default settings and the subsequent modification of the settings employed.
- The developers could provide a clear description of the scenario that is represented by the default settings; i.e., the conditions that they intend the default settings to represent. Guidance

could therefore be provided by model developers on the suitability of specific default settings for representing particular real world conditions.

- The developers could provide a clear description of the impact of changing model parameters or data-sets upon the results. This could be couched in a broader discussion on the impact of key model parameters upon the model's performance and the results subsequently produced.
- The developers could use an unambiguous terminology to describe the settings/parameters available (including the default settings), and their intended use. This should then, at least, minimize the likelihood of misunderstanding.
- The developers should ensure that the parameter values and settings employed within a scenario are echoed along with any results produced. This should reduce the likelihood of parameter settings mistakenly being applied, and then the results being misunderstood.
- The developer should clearly distinguish between, and explain the limitations of, those assumptions that are hardwired (i.e., internal assumptions that are not user-accessible), and those to which the user has access.

These suggestions represent a small number of actions that would help in the presentation and development of default settings. There are also a number of other broader measures relating to general model documentation, the design and validation process, and user training that would also assist in the user's understanding of the model's parameters. However, these are beyond the scope of this paper.

CONCLUSION

Default settings can be useful tools in the initial use of a model. It provides a method for model developers to guide the user in their selection of model parameters. However, care should be shown when using a model: the user should not assume that the default settings employed are applicable to the project at hand. This certainly requires care and attention on behalf of the user. The temptation to follow default settings may increase with model complexity, increase in application areas, and widening of user expertise.

Developers can also aid in the understanding of the default settings employed. Suggestions have been made on improved descriptions of the initial default setting selection, model output, the impact of model settings, the assumptions on which they are based, and scenarios for which they are intended. In this manner, default settings can be better understood and more appropriately applied.

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