



COLLEGE OF INFORMATION SCIENCES AND TECHNOLOGY THE PENNSYLVANIA STATE UNIVERSITY

Naming and Numbering of the IST "Technology Bridge": A Theoretical Analysis also Informed by a Survey of Penn State Undergraduate Students

Report to Penn State administration and an Example Class Project for IST 331 http://acs.ist.psu.edu/ist331/example-projects/

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Abstract / Executive summary

The IST Building should be and is being renamed and its rooms renumbered. We report here a study on renaming the building and provide the suggestion that a name using '*bridge*' would be better accepted, better used, and more consistent with PSU's noted values, and is already being used. It would also be a safer choice with fewer risks. We note some constraints on building room numbering based on published theories on navigation and cognitive psychology, and a small empirical study. We use these theoretical constraints and study to suggest a renumbering scheme that satisfies most of those constraints. Using this numbering approach based on data and theory should reduce navigation risks and increase acceptance of the numbering scheme and the new building name.

Acknowledgements

We thank Kelly Harris from the Office of Physical Plant for several interesting discussions since September 2016, when we first met. The conclusions are entirely ours however, and any mistakes are ours. We thank the 120 students of IST 331 Fall 2016 for participating in the study. We thank the numerous colleagues and students, here and at other universities, who have spoken to us the hall or sent us emails about this process, and those who gave extensive comments on this report.

IST buildingV7.doc

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1. Introduction

The IST Building is being considered for renaming and renumbering due to problems with its name and with the number scheme of its rooms. This is appropriate. There are major problems with the naming and numbering of the building, several of which are noted in Table 1.

Table 1. Current problems in the IST building

- a) The name does not reflect both units in the building
- b) The main auditorium on the second floor west has a number indicating that it is on the first floor east.
- c) The entrances are not named and there is not a main entrance
- d) The numbering of rooms does not match a mental model that new users have nor that first responders will have

This report summarizes data and theory about the naming and numbering of the IST building. It uses data gathered formally from one stakeholder group (students) and informally from another stakeholder group (IST faculty, some of whom who are qualified as legal experts in this area). It also uses theory from human-computer interaction and cognitive science about mental models, navigation, and stimulus-response compatibility (Ritter, Baxter, & Churchill, 2014).

It will note some risks of the current approach, some risks that remain in the proposed scheme (as it is known to us), and a way to reduce risks and increase stakeholder buy-in from a revised name and numbering scheme.

1.1 Current situation

Currently, the building is called "The IST Building", or "The Information Sciences and Technology Building". These names emphasize one of the two units in the building, the College of IST, over the Department of Computer Science and Engineering (CSE) in the School of Electrical Engineering and Computer Science in the College of Engineering. This emphasis of another unit in the name is undoubtedly uncomfortable to the CSE unit and may lead in several ways to confusion about their unit and navigation to it.

The numbering scheme of the building starts with 101 on the east (campus) side of the bridge and runs (as you travel west) to 110 on the disconnected first floor starting again at 111, to 240 on the disconnected but accessible second floor, and from 301 to 380 on the third floor. The numbers do not distinguish which side of the building rooms are on, and are inconstant across levels. The numbers offer relatively few directional cues while navigating particularly on the first floor that jumps between sides between 110 and 111, which seems premature to most users. This numbering violates most of the constraints discussed below, except that it is sequential from east to west.

Problems with the numbering scheme has been addressed informally in several ways. The current users have put up signs in the building noting where rooms are and how to navigate to

them; two are shown in Figure 1. The IST area on the first floor east has gone to a swipe access only to reduce the number of enquiries among the non-receptionist staff. Students in Ritter's IST 331 undergraduate and IST 521 graduate courses on human-computer interaction have also noted how the numbering of the building is a problem (Ayer & Kim, 4 May 2010; Oknefski, Hanson, Kaulius, Daouphars (Group 1), 15 December 2015).



Figure 1. Informal navigation guidance in the IST Building.

Ritter has met personally and helped direct two first responders (a police auxiliary and an emergency medical technician) to rooms. Getting first responders to rooms is thus not only likely to be a problem, but has been a problem. A report by students in Ritter's graduate HCI class (Oknefski et al., 15 December 2015) suggested that the current numbering lead to about a 50% slower travel time through the building for new users.

1.2 Existing proposal for renaming and renumbering

We understand that the proposal is to rename the building 'Westgate', and that the rooms be renumbered at the same time (Harris, 2016). The renumbering scheme uses East and West extensively, which will provide some directional cues. A user study in 2015 (Oknefski et al., 15 December 2015) concurs with this suggestion for room numbering.

The numbering of the building in this proposal is based on a circular pattern from an elevator tower named tower 1 on the IST side (east) and then from another tower on the west side. In this scheme several known problems (like the auditorium's number moving from an east first floor-like number to a mid-building second floor number) have been removed.

The signage proposed to be used to indicate room numbering also meets every constraint and requirement (font, color, etc.) known to us. Some problems remain, which will be taken up below.

We do not believe that any user study has been performed, and we do not know of any discussion with the faculty or student stakeholders in the building.

There are several problems with the Westgate name, although it does remove the main problem with confusion of a unit being in a building named after another unit.

- 1. There is what can be called the Schickele effect. Professor Peter Schickele, a musical comedian, was educated, he says, at the U. of Southern North Dakota. The room numbering scheme will have rooms that are East Westgate and West Westgate. This is literally a funny naming scheme, which creates cognitive dissonance, difficulty memorizing locations, and already, ridicule.
- 2. Thus, these names are likely to be edited to simply 303 Westgate, removing the second 'west' as a typo; this type of copyediting to remove unexpected duplication incorrectly can be seen in a recent popular novel where duplicate but necessary phrases were removed (Weir, 2014, p. 334, and personal communication with Weir).
- 3. Gates are used as an exclusionary device, something to keep people out.
- 4. Westgate has several unattractive connotations, including a casino and a mall in Kenya where there was a mass shooting. Thus, including the building name in emails as part of a signature block will increase spam scores.
- 5. An informal commentator and writer who does not work in the building noted that words ending in "-gate" are now often associated with scandals, which is a further risk for Penn State.
- Finally, looking up 'westgate' in the Urban Dictionary (http://www.urbandictionary.com) notes several extremely unattractive terms and definitions.

1.3 An evidence and theory based proposal

This report uses a quick study of one large user group and stakeholders, IST undergraduate students, an informal survey of another important stakeholder group (IST faculty and staff), and theory from human-computer interaction and cognitive science to propose an alternative name that is well accepted and avoids the risks that both the current and proposed name have, and avoids several risks that the current and proposed room numbering scheme has.

2. Study with undergraduate students

As part of looking at the room renumbering project Ritter did a survey with students in IST 331, "Foundations of User-Centered Design". This study was designed to start to explore the mental models of the building and also to explore names for the building using a larger pool of stakeholders.

2.1 Method

There were 124 students; they were in 32 groups of 4. All groups participated and 28 groups turned in comments in the next class. Most students were juniors, but some were sophomores and seniors, and there were two graduate students who are auditing the class. Students were given a small amount of extra credit for participating. We thus got a major user group to participate and had a large number of people think about it.

The students asked them to number rooms (on a schematic map) and to suggest names for the building. We did this to get help with the Schickele problem (the east west gate and west west gate problem, based on the University of Southern North Dakota at Hoople), and also to touch base with a major stakeholder and user in this process, students.

2.2 Results

All of the responses numbered the rooms either from an end or the middle of the building. None of them started numbering in the middle of a side.

The numbering results lead to a few insights. These included numbering the labs as pods (which we can't really use, on the map these are clearer grouped than in the hallways), and perhaps label the labs on cross corridors as being close to a decade number, e.g., 310, 320, 330, etc.

The students also generated more than 60 potential names as well. Some were silly, but "bridge" was mentioned 20 times; it was the most common name by far. Good choices put forward were

The Bridge Technology Bridge Tech Bridge West Bridge

Because the building serves as a bridge, it is also consistent with http://guru.psu.edu/policies/AD05.html, which notes that buildings should be named by function. And, it is consistent with the name local high school students being recruited also call it (Lewis, personal communication).

3. Proposed building name: to include "Bridge"

So, a major result that we can put forward is that "[Donor name] Technology Bridge" tests very well with two major stakeholder groups (students and, informally, faculty), was suggested very often formally by students and informally by faculty, and would solve the Schickele problem. It would also support the building groups wanting to be distinct (one is East and one is West).

We would thus have East Technology Bridge, and West Technology Bridge. The acronym, WTB and ETB appear to be benign. There is room for a donor name. We could also note that the name was put forward by students rather than an anonymous committee.

There are three reasons for naming the building a bridge. (a) The first is that, literally, the building is a bridge, and it was designed to look like the Ponte Vecchio Bridge by the architect, and designed to "bridge" technology with the campus, while bridging Atherton¹.

(b) The second semantic reason is that it has deep meaning to the school in the building besides IST. Electrical Engineering uses a bridge; it is part of the initiation ceremony of the electrical engineering honorary HKN. A bridge is a fundamental electrical circuit that includes the concept of balance.

(c) Perhaps most important of all is a marketing reason: a bridge is inclusive. The primary definition of a gate is a barrier. The primary definition of a bridge is a connection. Thus, a gate is exclusionary, and a bridge is inclusionary.

Very many of the faculty, staff, and students would much rather work in a building named to be inclusionary rather than exclusionary. Penn State could use some positive PR on inclusion.

Being inclusionary is more of a core Penn State value, we hope, than being exclusionary. At least, it is for us.

4. Proposed renumbering scheme

Table 2 provides a list of constraints on numbering the building. These were created based on stimulus-response compatibility, mental models, spatial cognition, and problem solving literature (Ritter et al., 2014, Chapter 6), being in the building, and existing studies on the usability of the building (Ayer & Kim, 4 May 2010; Oknefski et al., 15 December 2015).

Table 2 is based on work about human navigation. Research shows that it is difficult for people to remain oriented when they move between floors inside buildings (Soeda, Kushiyama, & Ohno, 1997). People need external artifacts to support their navigation, including floor plan maps, signage, and room numbers (Weisman, 1981). These aids help people know where they are and where their destination is, and then decide where to go. In a complex building like IST, it is important for a person to know which side of the building, which floor, and which particular section of a floor he/she is, as well as the same information about a destination. Further review is available for most of these constraints.

¹ http://vinoly.com/works/pennsylvania-state-university-college-of-information-sciences-and-technology/

Table 2. Constraints on room numbering.

- 1. Room numbers should line up across floors, e.g., 104 should not be below 320.
- 2. The break on the first floor should not be confusing
- 3. Rooms on the second floor should have a "2" not "1" as a leading digit
- 4. Rooms on an end should not be in the middle of the century (e.g., 250).
- 5. The number of users and size of room should influence the numbering scheme
- 6. Numbering should allow for room expansion (e.g., splitting a room into two rooms),
- 7. Should not use 'west' and 'east' if the building has 'west' in its name, e.g., 215 west west will get us in trouble
- 8. Should pilot test the numbering scheme with first responders and users, not just ask them, navigating from a floor plan is not the same as navigating from first person view
- 9. Users expect odd and even on different sides of a corridor (Ayer & Kim, 4 May 2010)
- 10. Users prefer to see numbers not left out (Ayer & Kim, 4 May 2010)
- 11. Rooms next to each other should have similar numbers
- 12. Suites can be numbered with a single number then the rooms can be labeled with letters
- 13. Exits should be numbered/named and be sympathetic to the room numbering
- 14. Know the number of rooms before starting (about 100 on each side of third floor)

It is difficult to meet all these constraints. The third floor has parallel but not equal length dual corridors and cross corridors. It is symmetric but not completely so, and there are essentially two towers that are disconnected on two floors. The first two floors are not connected, and so on.

A numbering scheme should be cognitively efficient to use. It should be easy to follow, be predictable, and allow people to use their prior knowledge (e.g., room numbers starting from one end of a floor, odd and even numbers on different sides of a hallway, special rooms having numbers easy to be memorized, etc.). Designs that violate these rules tend to have higher cognitive costs, and force people to apply different strategies in problem-solving (Gray, Sims, Fu, & Schoelles, 2006; Ritter et al., 2014, Chapter 6). In time-critical situations (e.g., building emergencies), this could mean more risks to the inhabitants.

Ritter and Zhang used a printout from Harris and numbered half the building. These proposed numbers follow the rules in Table 3, and use the general scheme shown in Figure 2. This general scheme could no doubt be redrawn with better style and used for both marketing and way finding. It might too be renamed from 'a coil' to something more appropriate.

This numbering scheme done with yellow stickies is shown in Figure 3. This scheme does not do all of the building, but shows that the scheme in Figure 2 can be applied to each floor, and that it does not have difficulty with the different floors nor with the cross corridors. It uses Harris's idea that the west tower includes the cafeteria area. It uses Harris's idea that there is a coil on the first floor and reapplies it to the areas that are created by tables currently on the second floor. It meets all the criteria in Table 1 except for the numbers of adjacent rooms being similar. It puts this anomaly on the research labs, which is where it will probably have the least impact.

We also saw (but did not use) that we could number the atrium separately, and that this might help with some symmetry problems.

Table 3. Number scheme rules.

- 1. The building is numbered on a dual coil shown in Figure 2. This provides a mental model that numbers go up one corridor on each floor; where the corridor can be seen to bend back, the numbering continues consecutively.
- 2. The outside room are labeled odd numbers, the inside rooms are even numbers, including labs on the cross corridors.
- 3. Labs are numbered by the even rooms near them (they are numbered with the corridor they are closest to).
- 4. Even numbers are skipped to match odd numbers across from them where necessary.
- 5. Exits are numbered, and are labeled with east and west. This supports first responders and deliveries and meetings to meet at places with canonical names.



Figure 2. The numbering scheme overview.



Third Floor



Second Floor



First Floor (rotated 180°)

Figure 3. Proposed numbering scheme for the IST Building. (Originals shared with Kelly Harris.)

5. Conclusions and recommendations

Renaming and renumbering the IST Building has several opportunities. It offers the ability to reduce confusion among the building's visitors, make the existing users happier, and more consistent with its use. It also has the ability to reduce the risks to the users by helping get first responders into the building faster and with less error.

The current proposal as known to us removes a major problem of the name not representing both units, but it does not satisfy other requirements. The proposed numbering scheme uses an innovative but unexpected numbering scheme that probably can be learned, but does not match standard building numbering.

1. Naming the building the "Technology Bridge" or some variant would support most requirements and appears to be preferred by two major stakeholder groups, IST students and IST faculty. CSE faculty and students should be equally consulted.

Renaming the building using the word Bridge rather than Gate would also note that Penn State or that these units in the building are inclusionary; a Bridge is inclusionary; a Gate is exclusionary. A gate directly notes exclusion and is used to exclude.

There are several other risks that "bridge" avoids, including unwanted associations with Westgate and the Schickele effect on numbering.

2. Numbering the rooms using a pair of loops starting at the ends would satisfy most requirements. The building's structure precludes satisfying all constraints, but we believe it is the best naming scheme available.

3. It would be useful to have some further user testing of the name and numbering scheme, and to complete the numbering scheme.

4. Not meeting these requirements would, however, allow further student projects on how to fix the numbering and meet these constraints.

We hope this report leads to additional time to find ways to satisfy the constraints that are inherent in this project; there probably remain further ways to improve the name and numbering scheme.

This report at least provides theoretical and empirical reasons for a rational basis for renaming and renumbering the IST building, and serves as an example report for students in HCI at Penn State.

About the first author

Frank Ritter is one of the first five professors hired in IST in 1999. He is a chartered psychologist in the United Kingdom; this allows him to give legal testimony in UK courts in this area.

His work has been supported by three governments, and he has completed over 35 funded research projects. He is an associate editor of the *Human Factors* journal and the *IEEE Systems, Man, and Cybernetics: Human-Machine Systems* journal. He was on the National Academy of Science committee that wrote *Human-system integration in the system*

development process: A new look (2007) for the National Research Council on risk-driven design. He edits a book series for Oxford University Press on cognition. He has a textbook on interface design used at over 15 universities co-written with the director of user experience for Google, which is being translated into Chinese. He was an initiate, chapter president, and Outstanding Senior of the HKN electrical engineering honorary at the University of Illinois.

About the second author

Luke Zhang is an associate professor in IST. He has conducted research related to spatial cognition and navigation. He has journal publications on theoretical models of navigation behaviors and systems to support spatial navigation, and serves as a reviewer and editor on visualization and navigation papers and grants.

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