



WPI

Impact of *NFPA 101 Life Safety Code* in Costa Rica

By:

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Introduction to WPI

- Located in Worcester, Massachusetts
- Technical school - mostly engineering majors
- Offer project sites in 28 countries
- Currently 12 projects in Costa Rica
 - San José has been a site since 1995
- Offers an FPE Masters and Certification Program

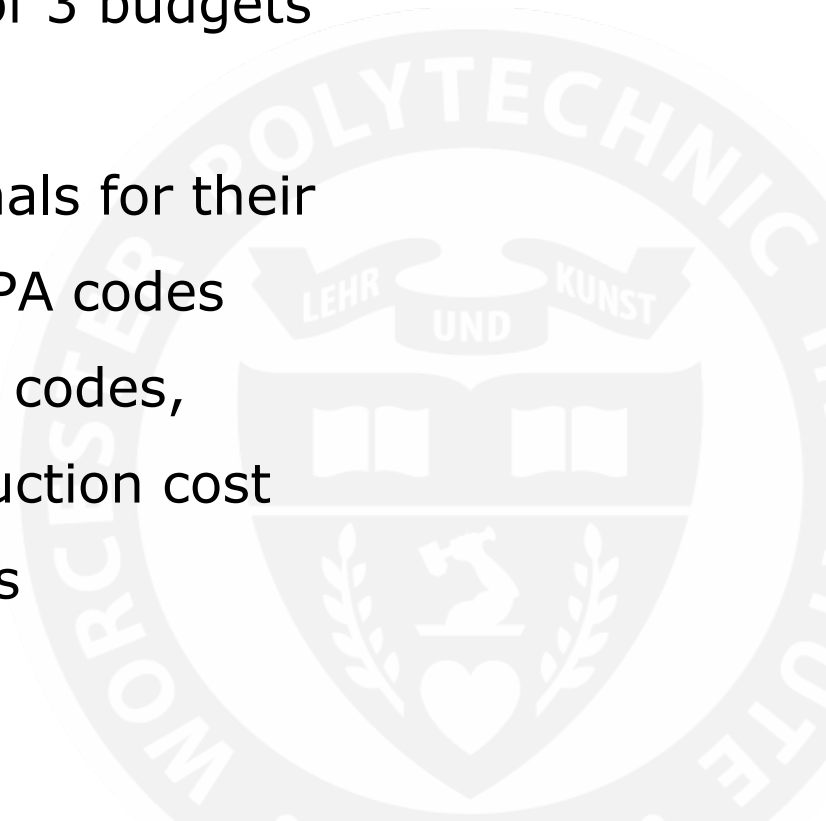


Our Project

- Understand why *NFPA 101 Life Safety Code* is not completely followed in Costa Rica
- Construction Budget cost analysis
- Interviews with various professionals
- Provide recommendations to improve NFPA code implementation

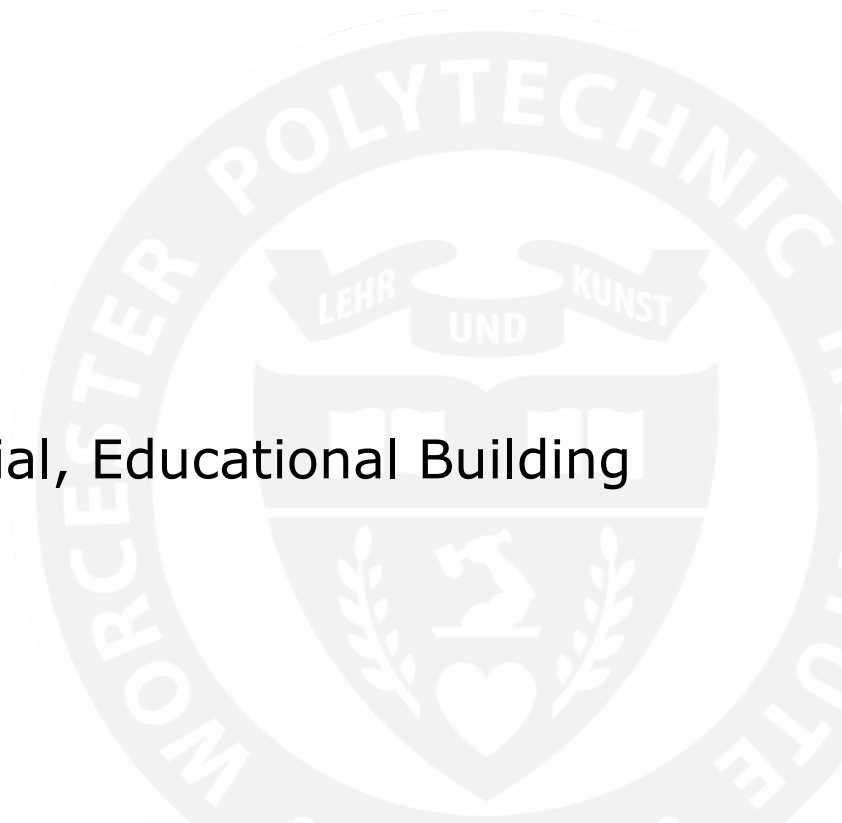
Methods

1. Researched background and history of NFPA codes, and its success in other countries
2. Construction budget analysis of 3 budgets provided to us by CFIA
3. Interviewed various professionals for their opinions and knowledge of NFPA codes
4. Determined feasibility of NFPA codes, recommendations, and construction cost increase caused by NFPA codes



Data Collection

- Interviews with Stakeholders
 - Benemérito Cuerpo de Bomberos de Costa Rica
 - Hospital Architects and Engineers
 - General Contractor
 - Material Vendors
 - Developers
 - Construction Authorities
 - CFIA
- Budget Analysis
 - Office, High-Rise Residential, Educational Building



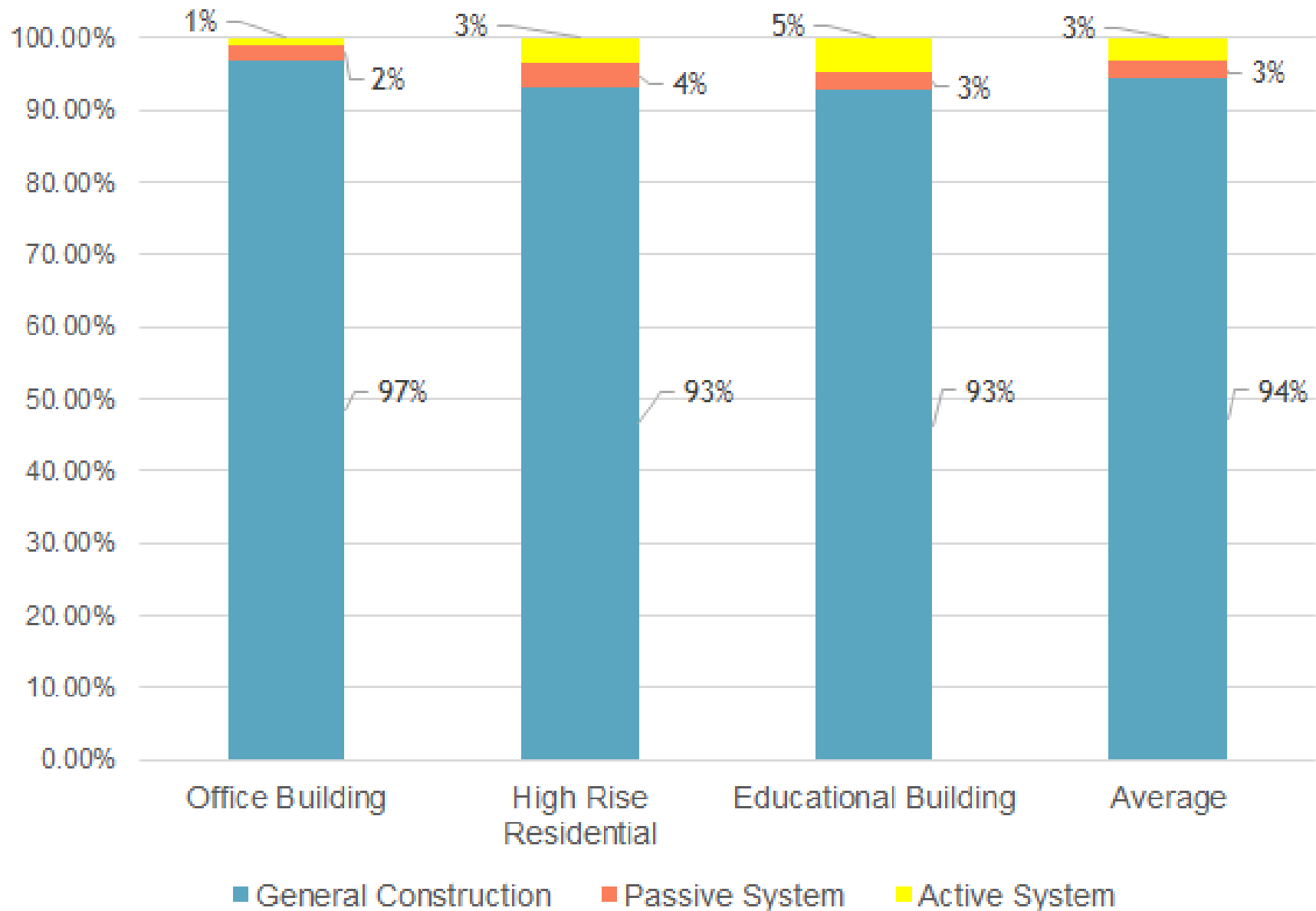
Findings

1. Construction Budget Analysis
2. Lack of NFPA Code Knowledge
3. Conflicting Information Between Bomberos Manual and NFPA Codes
4. Old Buildings Complying to NFPA Code
5. Availability of Fire-Rated Materials
6. Observed Deficiencies of NFPA Code Compliance

1. Construction Budget Analysis

- Analyzed budgets looking for cost increase caused by fire protection materials
 - Passive system includes walls, doors, ceilings
 - Active system includes extinguishers, sprinkler systems, standpipe systems
 - Indirect cost associated included
- Created graph of active system and passive system increase for 3 buildings and average of all 3
 - Buildings range from \$10 million to \$20 million
- Increase varies due to several factors
 - Optimization, NFPA 101 Requirements, Implementation

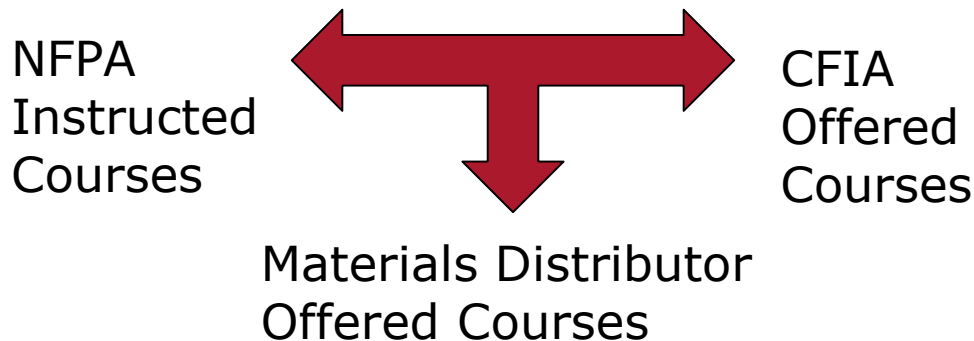
Percent Impact of *NFPA 101* Life Safety Measures on General Construction Costs



2. Lack of NFPA Knowledge

- Universities offer no passive Fire Protection courses
 - Offer an “Emphasis” on Fire Protection Methods and Active Systems
- Architects with the Passive System

SOURCES OF KNOWLEDGE

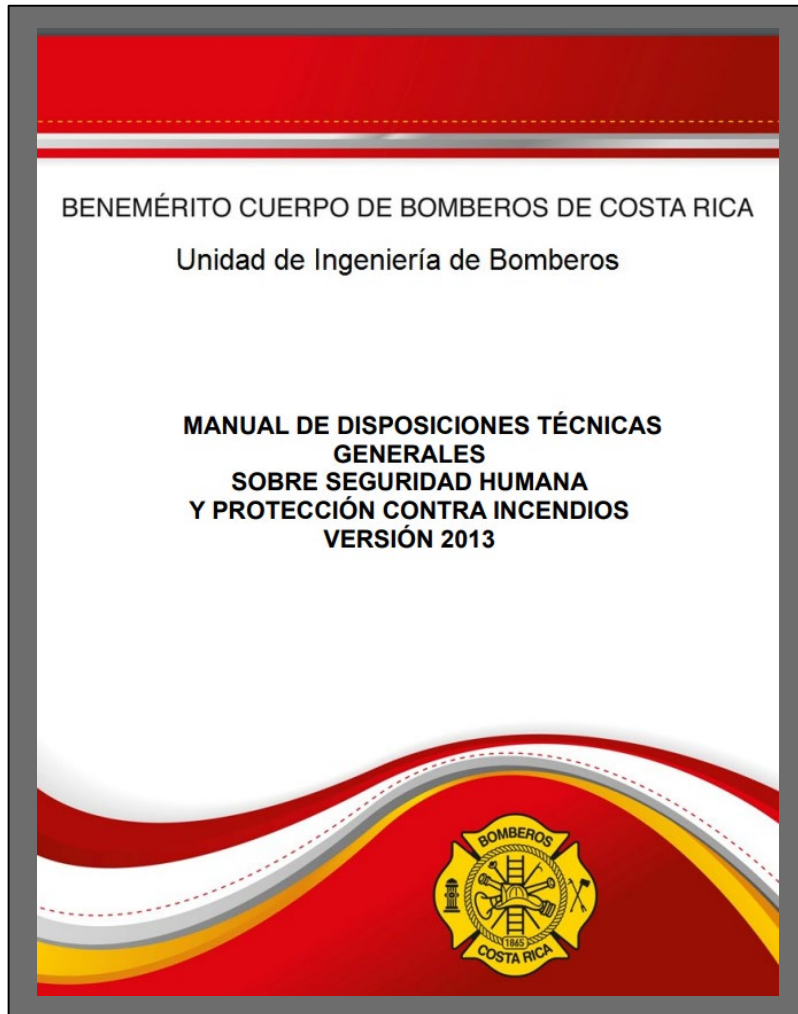


3. Conflicting Information - Bomberos Manual and NFPA Codes



- Bomberos Manual
 - Explanatory guide based on NFPA codes and standards
 - Being used as a reference during construction process instead of NFPA codes
- Bomberos want to make it a national code
- Reviews and Inspections
 - Inconsistent - leads to failed inspections resulting in lost time and money
 - Avg. building process is 2 years

3. Conflicting Information - Bomberos Manual and NFPA Codes



- Note that this is the most recent version of the Manual - from 2013
- New version is said to be published this year

4. Old Buildings Complying to NFPA Code

- The NFPA Codes were adopted around 15 years ago
- Most buildings constructed before 2005 are not compliant with *NFPA 101: Life Safety Code and the Costa Rican Construction Code*
- Most old buildings are not suited to follow the NFPA code
 - Ex. Low Ceilings, messy electrical lines, no compartmentalization, messy water pipes, narrow hallways, and much more

5. Availability of Fire Rated Materials

- Fire-rated materials are easily accessible in Costa Rica

Material Vendors

Professionals



Most aren't prepared to sell fire-rated assemblies

Most do not understand accessibility and use of fire-rated materials

Gold Bond® BRAND FIRE-SHIELD® C GYPSUM BOARD
1/2" Tapered Edge Type X Core

MANUFACTURER
National Gypsum Company
2301 Resford Road
Charlotte, NC 28211
(704) 365-7300
Technical Information:
1-800-NATIONAL
(1-800-628-4662)
Fax: 1-800-FAX-NGC
(1-800-329-6421)
http://net.Home.Page:
nationalgypsum.com
mailto:nationalgypsum.com@panol
09-29 00NCGC Buy Line: 1100

DESCRIPTION
Both Gold Bond® BRAND Fire-Shield® Gypsum Board and Fire-Shield® C Gypsum Board are manufactured with a Type X core to achieve fire-resistance ratings when used in recommended assemblies. Refer to the latest edition of National Gypsum Company Gypsum Construction Guide for details of specific fire-rated assemblies.

BASIC USES
Fire-Shield Gypsum Board was developed to work in combination with other products in specific assemblies to protect a building from fire for certain intervals of time. Fire-Shield Gypsum Board offers greater fire-resistance than regular gypsum board and is used to prevent rapid heat transfer to structural members for specified periods of time.

ADVANTAGES
• Fire Resistance: Depending on the assembly, Fire-Shield and Fire-Shield C Gypsum Board can be used to achieve wall and/or ceiling fire ratings of three-quarters of an hour to four hours.
• Core Integrity: Incombustible fibers in the core maintain core integrity to prevent cracking and heat transfer during fire.

Ease of Installation: Fire-Shield and Fire-Shield C Gypsum Board are installed in the same manner as regular gypsum board.

LIMITATIONS
• Exposure to excessive or continuous moisture and extreme temperatures should be avoided. Gypsum board is not recommended where it will be exposed to temperatures exceeding 125°F (52°C) for extended periods of time.
• To prevent objectionable sag in gypsum paneled ceilings, the weight of overlaid unsupported insulation should not exceed the following recommendations:

PSF (lb./sq. ft.)	Type	Frame Spacing
1.3	1/2" (12.7 mm) Fire-Shield	24" oc. (610 mm)
8.4 (kg/m ²)	1/2" (12.7 mm) Fire-Shield C	
2.2	1/2" (12.7 mm) Fire-Shield	16" oc. (406 mm)
2.2	5/8" (15.9 mm) Fire-Shield	24" oc. (610 mm)
10.7 (kg/m ²)	5/8" (15.9 mm) Fire-Shield C	

• If required, a vapor retarder can be installed in exterior ceilings and plenum and attic spaces should be properly ventilated.
• Installing gypsum board panels over an insulating blanket, installed continuously across the face of framing members, is not recommended. Blankets should be recessed and ladders attached to the sides of the studs or joists.

TYPES
Fire-Shield has a Type X core to achieve fire-resistance ratings when used in recommended systems.

Fire-Shield C has a Type X core with a mineral core additive to achieve superior performance when used in specific fire-rated assemblies.

SIZES

Fire-Shield Thickness	Width	Length
1/2"	4'	8' to 16'
5/8"	4'	8' to 14'
1/2"	4'	1219 mm (1182-4875 mm)
5/8"	4'	1219 mm (1182-4875 mm)

APPLICABLE STANDARDS
ASTM C 1396 Type X
Federal Specification SS-130D Type III Grade X

SURFACE-BURNING CHARACTERISTICS
ASTM E 84
Flame spread: 15
Smoke developed: 0

UL (Fire-Shield only)
Consult the UL Fire Resistance Directory for specific designs. Gold Bond Fire-Shield Gypsum Board has been UL Classified. UL designations are FSW-C, 1/2" and 5/8" Fire-Shield C FSW - 5/8" Fire-Shield



6. Observed Deficiencies of NFPA Code Compliance

- Common and constant in nearly every building we've been to
- Variety of issues
 - Means of egress, signage, fire extinguishers, meeting points, sprinkler systems, fire-rated materials
- Indicative of the lack of public knowledge and professionals knowledge

6. Observed Deficiencies of NFPA Code Compliance



Recommendations

1. The CFIA should publicize information on budget analyses of fire protection, which prove that fire protection systems are not a major cost burden.
2. The Bomberos must respect the purpose of the Explanatory Manual and eliminate the goal of making the Manual into a local code.
3. The CFIA, CIEMI, and especially CACR should promote NFPA courses, seminars, and workshops within the country, encourage their members to attend them and apply the knowledge, and work with the NFPA to ensure that courses are easily accessible.
4. The Ministry of Health and Bomberos improves the inspection process, clarifies the order of authority within the building industry, and employs more certified professionals to ensure that buildings are complying with NFPA codes.

1. CFIA to Publicize Budget Information

- CFIA must promote the knowledge that NFPA code compliance does not cause a large financial burden
 - Seminars, workshops, and visual aids etc. to disburse this information
- Support this knowledge to help eliminate misconceptions within the industry
 - Passive system adds 2%-4% to construction costs
 - Active system adds 1%-5% to construction costs

2. Clarify Role of Bomberos' Manual

- The Manual is an Explanatory Handbook
- Cannot be referenced as it currently is in the review process
 - Gives construction professionals a sense of uncertainty for time and money
- Eliminate process of making it a code
 - Lack manpower and knowledge for the upkeep of editions

Bomberos' Manual  **NFPA Codes and Standards**

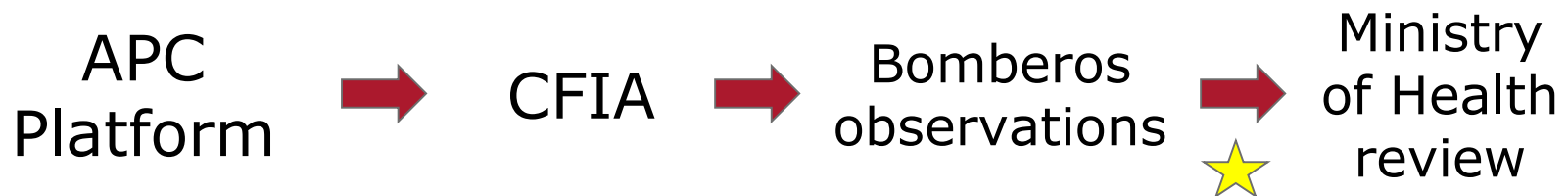
- NFPA codes and standards will supercede all

3. Promote the NFPA Codes

- There is a lack of knowledge about NFPA codes in Costa Rica
 - professionals need to be encouraged to take NFPA courses from the CFIA or directly from the NFPA
- The courses offered at CFIA are half the price compared to ones offered by the NFPA
- There are ample learning opportunities in the forms of courses seminars and workshops in Costa Rica to teach professionals about NFPA code.

4. Ministry of Health

- Ministry of Health and Bomberos should **improve the inspection process**
- **Clarify the order of authority** within the building industry
 - Bomberos has too much responsibility in inspections
- **Employ more certified professionals** to ensure that buildings are complying with NFPA codes



Acknowledgements

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The background features a large, semi-transparent circular logo of Morcester Polytechnic Institute. The logo contains a central shield with a hammer and anvil, a heart, and a banner above it that reads "LEHR UND KUNST". The outer ring of the logo contains the text "MORCESTER POLYTECHNIC INSTITUTE" and the year "1865" at the bottom.

Any Questions?