ASTM Committee F45 9th Bi-Annual Meeting



Roger Bostelman Chairman, ASTM Committee F45 NIST

> Karen Murphy ASTM F45 Staff Manager

April 30-May 1, 2019 Lowell, MA



Agenda Day 1

Tuesday, Apr 30	UMass Lowell NERVE Center	
Start	Event	Lead
8:00 AM	Greetings, Introductions, Agenda	Bostelman
8:10 AM	UMass Lowell Greeting and Presentation	UML, Norton
8:30 AM	F45.90 Executive Committee meeting - history overview, status, officers, ASTM information, etc.	Bostelman, Murphy
9:00 AM	F45.01 Environmental Conditions	Bostelman
9:30 AM	Coffee Break	
9:45 AM	F45.91 Terminology - A-UGV Capability Levels	Bostelman
11:45 AM	Lunch	
12:45 PM	F45.02 - Navigation and Docking	Roberts
2:45 PM	Coffee Break	
3:00 PM	Day 1 wrap-up and next day agenda	Bostelman, Norton
3:15 PM	Demonstrations: Vehicle capabilities, environmental conditions, docking, navigation, obstacles (communication impairment?)	Norton
4:45 PM	Adjourn	
6:00 PM	Dinner - The Keep	

Agenda	Wednesday, May 1		UMass Lowell NERVE Center	
	Start		Event	Lead
Day Z	8:00 AM	0:15:00	Day 2 agenda review, logistics, etc.	Bostelman
	8:15 AM	2:00:00	F45-03 Object Detection & Protection - Describing Obstacles (Static and Dynamic)	Norton
	10:15 AM	0:15:00	Coffee Break	
	10:30 AM	2:00:00	F45-04 Communication & Integration - Comm. Impairment	Holmberg
	12:30 PM	0:30:00	Lunch	
	1:00 PM	0:30:00	Fleets	Reynolds
	1:30 PM	2:00:00	Building block standards	Norton
	3:30 PM	0:15:00	Coffee Break	
	3:45 PM	0:30:00	Main Committee - Subcommittee Reports, Future works	Bostelman
	4:15 PM		Adjourn	
	4:00 PM to 5:20 PM	1:15:00	ASTM interviews and video recording	LaFary, Roberts, Norton, Bostelman
	6:00 PM		Dinner - Lowell Burger Co.	

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Dinners

- Monday Fuse Bistro, 10 minute walk
- Tuesday The Keep, 10 minute walk
- Wednesday Lowell Burger Co.

Name	A ((1) - 1)		T	Wednesday
Name	Affiliation	wonday dinner	Tuesday dinner	ainner
Bostelman, Roger	NIST	yes	yes	yes
Ferman, Ahmet M	Omron Adept Technologies		yes	yes
Gates, Rusty	Universal Parks and Resorts		yes	yes
Ghataore, Gurpreet	The Manufacturing Technology Centre			Vac
Holmherg Robert	Google		yes	yes
Holmberg, Robert	Google	yes	yes	
Jordan, Adam	The Manufacturing Technology Centre		Ves	ves
LaFary, Matt		Voc	,	,
Li Oiang	Shenzhen Click Technology	yes	yes	yes
Navias Asthenus				
Marino, Anthony	SOSV HAX			
Messina, Elena	NIST	yes	yes	
Murphy, Karen	ASTM International	yes	yes	yes
Noelte, Greg	Sensata Technologies		yes	
Norton, Adam	University of Massachusetts Lowell	Ves	Ves	VAS
Pedersen, Christian Have	Mobile Industrial Robots	yes	yes	yes
Revnolds Todd	Omron Adent Technologies	yes	yes	
Delevite Melecles T			yes	yes
Roberts, Malcolm I	BR2 Consulting			
Sarbak, Emre	Mediate			
Sparrow, Mary Ellen T	Next Shift Robotics			
Vogtman, Randall	Oceaneering International, Inc		yes	
Yanco, Holly	University of Massachusetts Lowell	ves	ves	
Davie Chric	ASTM International	,	,	
Davis, CIIIIS		yes	yes	
Huang, Ahing	ASTM International	yes	yes	yes

Introductions

- Name
- Organization and your role
- F45 Member or Guest?

Welcome and Overview University of Massachusetts Lowell

- Julie Chen, Vice Chancellor for Research and Innovation
- Adam Norton, NERVE Center Assistant Director New England Robotics Validation and Experimentation



F45.90 Executive Subcommittee Meeting

Roger Bostelman

Chairman, ASTM Committee F45

Karen Murphy ASTM Staff Manager

April 30, 2019

Committee Officers & ASTM Staff

F45 CHAIRMAN F45 VICE-CHAIRMAN F45 SECRETARY F45 MEMBERSHIP SECRETARY Bostelman, Roger LaFary, Mathew Norton, Adam LaFary, Mathew

F45.01 SUB-CHAIRMAN F45.02 SUB-CHAIRMAN F45.03 SUB-CHAIRMAN F45.04 SUB-CHAIRMAN F45.91 SUB-CHAIRMAN Bostelman, Roger Roberts, Malcolm Norton, Adam Holmberg, Bob Bostelman, Roger

ASTM STAFF MANAGER ASTM ADMIN ASSISTANT ASTM EDITOR

Murphy, Karen McKeever, Marianne Rosborough, Mark Environmental Effects Navigation and Docking Obstacle Detection and Protection Communication and Integration Terminology

Membership/Attendees

Committee	July 2018	Dec 2018
F45	49	51
F45.01	22	27
F45.02	35	39
F45.03	41	45
F45.04	36	40
F45.91	27	32

Classification	Dec 2018
Producer	21
User	8
General Interest	22

Countries
Canada
China
Finland
India
Japan
Russia
Singapore
Sweden
Switzerland
UK
USA

Key Roles to fill

 F45.01 Chairman – Environmental Effects

Recent New Members

• Ockwoo Nam, Korean Intellectual Property Office

• Constantine Panagotacos, Dunn Panagotacos Attorneys at Law

ASTM F45 Committee Accomplishments

Eight (8) Bi-Annual Face-to-Face Meetings

• And at least once per year, these meetings also hold demonstrations of standards being developed.

<u>Two Workshops</u>

- First Workshop at IEEE ICRA 2015
 - Ten (10) papers were presented and discussions followed
 - Published ASTM book STP1594 "Autonomous Industrial Vehicles: From the Laboratory to the Factory Floor"
- Second Workshop with July 2018 meeting
 - Developed new work items:
 - A-UGV Capabilities (and a roadmap to future standards development)
 - Combining A-UGV Standards (e.g., navigation, docking, obstacles, communication impairments, etc.)

ASTM Awards

- Robert J. Painter Memorial Award
- James A. Thomas President's Leadership Award
- Two (2) Awards for Outstanding F45 Participation

NIST Website

<u>https://www.nist.gov/el/intelligent-systems-division-73500/unmanned-ground-vehicles-research-and-standard-test-methods</u>

ASTM F45 Meeting #8 Annecy, France hosted by Omron



ASTM F45 Committee Accomplishments

Standards and Work Items

- Published standards
 - 1. F3200-17,18 <u>Terminology</u> for Driverless Automatic Guided Industrial Vehicles
 - 2. F3218-17 Standard Practice for Recording <u>Environmental Effects</u> for Utilization with A-UGV Test Methods
 - 3. F3244-17 Standard Test Method for <u>Navigation</u>: Defined Area
 - 4. F3265-17 Standard Test Method for Grid-Video Obstacle Measurement
 - 5. F3327-18 Standard Practice for Recording the A-UGV <u>Test Configuration</u>
- Work Items
 - 1. <u>F45.01</u> WK54576 Standard Practice for Recording <u>Environmental Conditions</u> for Utilization with A-UGV Test Methods
 - 2. <u>F45.02</u> WK57000 Standard Test Method for <u>Docking</u> Driverless Automatic Guided Industrial Vehicles
 - 3. <u>F45.02</u> WK65141 Standard Guide for <u>Combining A-UGV Standards</u>
 - 4. <u>F45.03</u> WK54662 Standard Practice for <u>Capturing A-UGV Positions</u> using Grid-Video Techniques
 - 5. <u>F45.03</u> WK60390 Standard Practice for Describing Stationary <u>Obstacles</u> Utilized within A-UGV Test Methods
 - 6. <u>F45.04</u> WK54431 Standard Practice for Implementing <u>Communications Impairments</u> on A-UGV Systems
 - 7. <u>F45.91</u> WK65139 Standard Guide for A-UGV <u>Capabilities</u>

Recent Ballots

	Ballot	Issue Date	Closing Date
Obstacles	<u>F45 (19-01)</u>	Mar 07, 2019	Apr 16, 2019

2018/2019 Ballots

	Letter Ballot	Issue Date	Closing Report Posted
Obstacles	<u>F45.03 (19-01)</u>	January 14, 2019	February 14, 2019
Env Cond.	<u>F45 (18-03)</u>	November 14, 2018	December 17, 2018
Test Config.	<u>F45 (18-02)</u>	May 11, 2018	June 18, 2018

Minimal votes ... again

COMMITTEE OFFICERS:

CHAIRMAN		Roger Bostelman
SECRETARY		Adam Norton
SUBCHAIRMAN	(0300)	Adam Norton

BALLOT STATISTICS:

Committee	Sent	Returned	% Returned
F45	43	26	60.46

Item	Sub	Action	Committee	AFF	NEG	ABST	PCNT
001	03	NEW STANDARD Practice for Describing Stationary Obstacles Utilized within A-UGV Test Methods	F45	18.00	1.00	7.00	94.73
		TECHNICAL CONTACT: Adam Norton					
		WORK ITEM: WK60390					

Negative Voters:

Hui-Min Huang

Comments:

Robert Holmberg

Inactivity	Committee	Affiliation/Contact	Consecutive Ballots Not Returned	Designation of Last Missed Ballots			Response from Voter
Report	Emanuel, David	1776007 Amerden Inc United States 302.463.6134 david.emanuel@dcemanuel.co m	4	(18-03) (17-02)	(18-02)	(18-01)	No Response
	Auguste, Carlet	2031285 United Technologies Aerospace Systems United States 779.348.4327 Carlet.Auguste@utas.utc.com	3	(18-03)	(18-02)	(18-01)	No Response
	Schwartz, Justin M	000423520 Universal Studios Orlando United States 407.224.3049 justin.schwartz@nbcuni.com	3	(18-03)	(18-02)	(18-01)	No Response
	Wysowaty, Walter	2041701 WMW Forensics United States 190.879.7551 walt@wmwforensics.com	3	(18-03)	(18-02)	(18-01)	No Response

F45.90 Admin.

Voting Inactivity

- A member was inactive for 5 ballots
- Possible mismatch in ASTM alerts
 - This org. has three members one voting and one redundant-non-voting the inactive member is *not* the voting member for the organization
 - i.e., why the alert?

More important for F45 Exec: need policy for how to handle more than X missed votes

- Alerts are sent by ASTM for missed votes
- Suggested policy: warning from the Exec Comm. after 3 missed votes that they'll be removed as a voting member if another vote is missed – can still participate in F45.
- What else can be done to get votes?
 - Continuous emails to members?

<u>Ballots</u>

Pixelated images on ASTM ballot postings.

Upcoming Meetings

• Monthly E-meetings:

1st Tuesday /month	1-3 PM ET
2nd Tuesday /month	1-3 PM ET
3rd Tuesday /month	1-3 PM ET
4th Tuesday /month	1-3 PM ET
	1st Tuesday /month 2nd Tuesday /month 3rd Tuesday /month 4th Tuesday /month

- Face-to-Face Meeting
 - 10th Bi-Annual Face-to-Face Meeting:
 - Where ?
 - When: Fall 2019
 - 11th Bi-Annual Face-to-Face Meeting:
 - Where ?
 - When: Spring 2020

F45.01 Environmental Effects Subcommittee Meeting

Roger Bostelman

Chairman, ASTM F45.01

April 30, 2019

F45.01 Agenda

Old business

- Modifying WK54576 Standard Practice for Recording Environmental Effects Conditions for Utilization with A-UGV Test Methods
 - Added test method references, boundaries, etc.
 - Ballot F45 (18-03) closed 14 Dec 2018
 - One negative and some comments
- New business
 - Review document prior to preballot/ballot
 - 4. Significance and Use; Gap/Step; etc.
 - Needs updated test reports



Standard Practice for Recording Environmental Effects for Utilization with A-UGV Test Methods¹



Work Item Number: WK54576 Date: 3/15/19

Standard Practice for RecordDocumenting Documenting **Environmental Effects Conditions for Utilization with A-UGV Test** Methods



Demonstrations

Adam Norton, NERVE Center Assistant Director New England Robotics Validation and Experimentation





F45.91 Terminology Subcommittee Meeting

Roger Bostelman

Chairman, ASTM F45.91

April 30, 2019

F45.91 Agenda

- Old business
 - No WK65139 A-UGV Capabilities
 - Developed *navigation* and *docking* capabilities



Standard Terminology for Driverless Automatic Guided Industrial Vehicles¹

- New business
 - Are there other terms from other standards to add to F3200?
 - WK65139 A-UGV Capabilities
 - Several proposed terms
 - Discuss table of A-UGV Capabilities



Old Business

	A-UGV CAPABILITY						
CLASSIFIER	3	4	5	6			
		Leaves preprogrammed					
Navigation	Follows	path and returns to	Can find an alternate				
	preprogrammed path	preprogrammed path	preprogrammed path	Self-routes to the goal			
- infrastructure							
dependence	relies on infrastructure	relies on infrastructure	relies on infrastructure	relies on infrastructure			
	does not rely on						
	infrastructure; corrects	infrastructure; corrects	infrastructure; corrects	infrastructure; corrects			
	for errors	for errors	for errors	for errors			
	Docks at						
Docking	preprogrammed	Able to adjust based on	Dynamic docking with				
	waypoints	local docking position	moving objects				
- infrastructure							
dependence	relies on infrastructure	relies on infrastructure	relies on infrastructure				
	does not rely on	does not rely on	does not rely on				
	infrastructure; corrects	infrastructure; corrects	infrastructure; corrects				
	for errors	for errors	for errors				
 docking degrees of 							
freedom	x (heading)	x (heading)	x (heading)				
	y (side-to-side)	y (side-to-side)	y (side-to-side)				
	z (vertical)	z (vertical)	z (vertical)				
	roll (rot. about x)	roll (rot. about x)	roll (rot. about x)				
	pitch (rot. about y)	pitch (rot. about y)	pitch (rot. about y)				
	vaw (rot. about z)	vaw (rot. about z)	vaw (rot. about z)				

New Business: A-UGV Capabilities

Goal Navigation: Pre- Programmed If encounters obstacle, can leave the preprogrammed path an alternate If blocked, can navigate multiple alternate Goal Navigation: In situ Can navigate a preprogrammed path to preprogrammed path to the goal. If blocked, can navigate an alternate If blocked, can navigate preprogrammed paths to the goal. E.g., navigate a hailway/aisle if the determine and navigate Goal Navigation: In situ Can determine and navigate an initial path to the goal. If blocked, can determine and navigate If blocked, can determine and navigate Goal Navigation: In situ Can determine and navigate an initial path to the goal. E.g., navigate a an alternate path to the goal. E.g., navigate a different hallway/aisle If blocked, can determine and navigate Goal Navigation: In situ Can determine and navigate an initial path to the goal If blocked, can determine and navigate If blocked, can determine and navigate Goal Navigate an initial path situ Can rely on fatures in the environment that were specifically correst cape, QR environment If blocked, can third hallway/aisle If blocked Goal Ravigate in the environment Given na initial pose, A- UGV can update it's environment map based on detected Given na initial pose, A- UGV can Given na initial pose, A- UGV can Given na initial pose, A- UGV can	CLASSIFIER			A-UGV CA	APABILITY	•	
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Localization Given an initial pose, A- UGV doesn't get lost in a Given that the A-UGV is correctly localized, it [becomes forcably unlocalized] gets picked up and moved to another location A-UGV can update it's environment map Biven an initial pose, A- UGV doesn't get lost in a (kidnapped), then it A-UGV can	environment	codes	racking	GPS?			
Localization Given an initial pose, A- UGV doesn't get lost in a Given an initial pose, A- UGV doesn't get lost in a					Given that the A-UGV is		
Localization Localization Given an initial pose, A- UGV doesn't get lost in a UGV doesn't get lo					correctly localized, it		
Localization Localization Given an initial pose, A- UGV doesn't get lost in a Given an initial pose, A- UGV doesn't get lost in a UGV doesn't get lost in a Comparison of the second detected DGV doesn't get lost in a Comparison of the second detec	Localization				[becomes forcably		
Localization up and moved to A-UGV can update it's Given an initial pose, A- Given an initial pose, A- another location Given an initial pose, A- UGV doesn't get lost in a (kidnapped), then it A-UGV can based on detected based on detected based on detected					unlocalized] gets picked		
Given an initial pose, A- Given an initial pose, A- another location environment map Given an initial pose, A- UGV doesn't get lost in a (kidnapped), then it A-UGV can based on detected					up and moved to		A-UGV can update it's
Given an initial pose, A-UGV doesn't get lost in a (kidnapped), then it A-UGV can based on detected				Given an initial pose, A-	another location		environment map
			Given an initial pose, A-	UGV doesn't get lost in a	(kidnapped), then it	A-UGV can	based on detected
A-UGV can find it's UGV doesn't get lost in a dynamic environment stops and requires automatically changes in the		A-UGV can find it's	UGV doesn't get lost in a	dynamic environment	stops and requires	automatically	changes in the
initial pose static environment e.g., e.g., warehouse with human intervention to determine its pose after environment (e.g.,		initial pose	static environment e.g.,	e.g., warehouse with	human intervention to	determine its pose after	environment (e.g.,
automatically. Office building pallets being moved restart being kidnapped. continuous SLAM)		automatically.	office building	pallets being moved	restart	being kidnapped.	continuous SLAM)
Can dock with a	Docking			Can dock with a			
Can position at moveable but,		can position at		moveable but,			
Docking preprogrammed stationary object, E.g.,		preprogrammed	Complete the state of the state	stationary object, E.g.,			
waypoints, E.g,, Can dock with a static another vehicle, pallet coordinated movement		waypoints, E.g,,	Can dock with a static	another vehicle, pallet	coordinated movement		

New Business: A-UGV Capabilities

Environmental conditions under which the A-UGV can operate	Mobility: Refer to ASTM F3218-18, section 4.9 Ground Surface for: elevation change up/down; gap; grade; deformability; undulation; floor particulates; coefficient of friction; boundaries (e.g., cold storage curtains)	IP Rating: refer to IP Rating scale, e.g., EN 60529 (British BS EN 60529:1992, European IEC 60509:1989)	list the env cond categories					
Obstacle Avoidance - Single Vehicle	Can stop when path is obstructed. E.g., pallet in the path.	Can navigate around static obstacles without collision. E.g., navigating around a box partially blocking a hallway	Can navigate around moving obstacles without collision. E.g., navigating around a moving vehicle that crosses the A-UGV path					
Types of objects that				elevated >= 20 cm and	elevated >= 20 cm and			
can be avoided and				within the A-UGV	with the A-UGV			
are within the A-UGV	on ground, < 10 cm	on ground, 10 to 20 cm	on ground, > 20 cm	envelope, < 10 cm	envelope, >= 10 cm			
envelope	obstacle height	obstacle height	obstacle height	obstacle height	obstacle height			
Types of objects that				elevated above the A-				
can be avoided and		negative obstacles, > 1	negative obstacles, > 10	UGV envelope and				
are outside of the A-	negative obstacles, <= 1	to <= 10 cm obstacle	cm obstacle height, E.g.,	within the vertical				
UGV envelope	cm obstacle height, E.g.,	height, E.g., removable	loading dock, cliff,	projection of the A-UGV	beside the A-UGV			
	missing tile	panel on a raised floor	manhole	envelope	envelope			
Information								
Sharing/Updating	one A-UGV information		Information from a	Information from a				
(e.g., presence of	is shared with <mark>one or</mark>	one A-UGVs	sensor connected to the	sensor connected to the				
obstacles,	more A-UGVs in its fleet	information is shared	A-UGV <mark>System</mark> informs	A-UGVS informs its fleet				
environment map	from the same	with its fleet from	its fleet from the same	from different	External systems can			
changes)	manufacturer	different manufacturers	manufacturer	manufacturers	inform the fleet			

New Business: A-UGV Capabilities

Fleet Navigation Coordination	Stop and wait for permission to use traffic zone (one A per traffic zone)	a A-UGV	Gets permission to u a traffic zone withou requiring stopping (c A-UGV per traffic zor	ise it one ne)	Stop and wait for permission to use a traffic zone (more than one A-UGV per traffic zone)	Gets permission to use a traffic zone without requiring stopping (more than one A-UGV per traffic zone)	Doesr zones comm fleet o other	n't require traffic , requires nunication with controller and/or vehicles	Doesn't rec zones, with communica fleet contro other vehic	uire traffic out requiring tion with Iller and/or les			define zone	
Fleet Makeup	Homogenous A-U	Heterogenous A-LIGVs same manufacturer		Vs,	Heterogenous A-UGVs, different manufacturer	· · · · · · · · · · · · · · · · · · ·								
Fleet Task Assignment	manual task assig - give each A-UGV own task	nment it's	automatic task assignment - give fle controller tasks to be performed by the A- UGVs	et e										
Fleet Task Coordination	tasks can only be when they are ab be executed	given le to	can give future time that task needs to oc	ccur	tasks are performed by one A-UGV but can only be performed by a subset of the fleet	tasks can require collaboration of multiple A-UGVs	can re of tas new t	eorder execution ks when given asks	tasks can h	ave priority	can change A-UG based on predict	GV performance ged future tasks	tasks can have dependen other tasks	ncies of
		Impa Com Beha	ired munication vior Communication	Wh imp and cor res hur ord ope Wh lost wh res hur ord ope	ten communication is baired, A-UGV stops d when nmunication umes, requires man intervention in ler to restart normal eration t, A-UGV stops and en communication umes, requires man intervention in ler to restart normal eration	When communicat impaired, A-UGV st and when communication resumes, does not require human intervention in order restart normal operation When communicat lost, A-UGV stops a when communicat resumes, does not require human intervention in order restart normal operation	ion is ops er to ion is nd ion er to	While commur impaired, A-UG modified opera E.g., drive slow While commur lost, A-UGV has modified opera E.g., drive slow	nication is GV has ation, ver nication is s ation, ver	While com impaired, normal op While com lost, contir operation	munication is continues eration munication is nues normal			

Red – existing F45.91 term/def

Blue – suggested changes

infrastructure – the immovable parts and features of the facility (e.g., walls, hills, doorways, navigation reflectors)

object, n—anything in the environment that-may or may not be an obstacle. [ASTM F3200-18] is not infrastructure

obstacle, n—static or moving object or feature that obstructs the intended movement. [ASTM F3200-18]

guidegrath, n-intended path for an A-UGV used with automatic or automated guidance. [ASTM F3200-18]

intended path, n—heading trajectory of a vehicle at a given instant in time dictated by the control logic, recognizing that the heading trajectory is a dynamic property and can change at any instant in time depending on conditions in the operating environment (for example, the decision to allow a vehicle to pass another vehicle or to navigate around an obstacle); see path deviation, guidepath. [ANSI/ITSDF B56.5] [ASTM F3200-18]

zone - predefined control area for coordinating A-UGV movement (e.g., traffic zones)

navigation aids - features in the environment that were specifically installed to assist in A-UGV navigation (e.g., guide tape, reflectors)

natural features, n—features in the environment that were not specifically installed to assist in A-UGV navigation. [ASTM F3200-18]

fleet - collection of vehicles coordinated to perform a function

contour area -

A-UGV envelope - A-UGV contour area + clearance

New Business

delete-local operator

New Business - meeting objectives

- Review terms/definitions to be used in the capabilities guide
- A-UGV Capabilities
 - Review capabilities spreadsheet informally approve
 - Continue drafting the standard guide

Subcomm. Notes

.03

- WK60390 Practice for Describing Static Obstacles
 - Negative Hui
 - 60% return, 66% sub, 90% main votes, all can vote regardless of status
- WK68031 Practice for Describing Moving Obstacles
 - Rigid: Doors swing, garage,
 - Soft: Curtains

.04

- Roger work with Bob H. to modify Fig 1:
 - add traffic control and cloud
 - add a new measurement figure showing the actual connections with the measurement device.

F45 Main Meeting

Roger Bostelman Chairman, ASTM Committee F45

> Karen Murphy ASTM Staff Manager

> > April 30, 2019

Main Agenda

- Subcommittee reports priorities
- F45 Main Officers 2 yr timeframe, 3 terms in a row
 - Nominated same Main officers through motion, 2nd
 - Karen will send nomination ballot around October for anyone else to become a Main Officer should they choose.
- F45 Promotion/Inform SDOs
- Next Meetings

Promoting F45

- Joint Standards
 - ITSDF B56.5 Driverless Automatic Guided Industrial Vehicle Safety
 - Roger presented F45 update at the February 2019 meeting, Sarasota, FL
 - MHIA requested F45 update for their AGV Focused meeting
 - Old Business:
 - RIA 15.08 Mobile Robot and Mobile Manipulator Safety
 - Roger presented F45, October 2018 meeting at NIST towards harmonization of terminology
- Video
 - work with editors to produce F45 promotion video
- Future Meetings
 - International (most members from USA) promoting F45 face-to-face is ideal
 - Demonstrations and/or real A-UGV installations to observe also ideal

Upcoming Meetings

• Monthly E-meetings:

1st Tuesday /month	1-3 PM ET
2nd Tuesday /month	1-3 PM ET
3rd Tuesday /month	1-3 PM ET
4th Tuesday /month	1-3 PM ET
	1st Tuesday /month 2nd Tuesday /month 3rd Tuesday /month 4th Tuesday /month

- Face-to-Face Meeting
 - 10th Bi-Annual Face-to-Face Meeting:
 - Where ?
 - When: Fall 2019
 - 11th Bi-Annual Face-to-Face Meeting:
 - Where ?
 - When: Spring 2020

Possibilities for Next Bi-Annual F45 Meetings Spring 2019, Autumn 2020

Suggestions for this meeting were:

- UMass-Lowell, MA, USA
 - April 29th May 3rd wk
- Fetch San Jose, CA, USA
- Robotnik Valencia, Spain (sent Roberto Guzman a LinkedIn message said "we could be interested")
- Balyo near Paris, France (sent Fabien Bardinet a LinkedIn message no reply)
- NIST, Gaithersburg, MD, USA
- Omron San Francisco, CA, USA
- Omron Netherlands

ASTM-Hosted Committee Weeks:

- Oct 21-25, 2019 Houston, TX
- Mar 30-Apr 3, 2020 Boston, MA
- May 11-15, 2020 Boston, MA

Suggestions for this meeting were:

- MTC (Catapult centers) Dyson UK
- MIR, also robot cluster Denmark
- Disney, Universal Studios Orlando, FL
- Mitsubishi, Diafuku, Sansei Japan
- Rocla Finland
- Technalia Spain