Management and innovation: Evidence from randomized experiments and repeated surveys in Vietnam

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https://sites.google.com/site/yukihiguchipage/
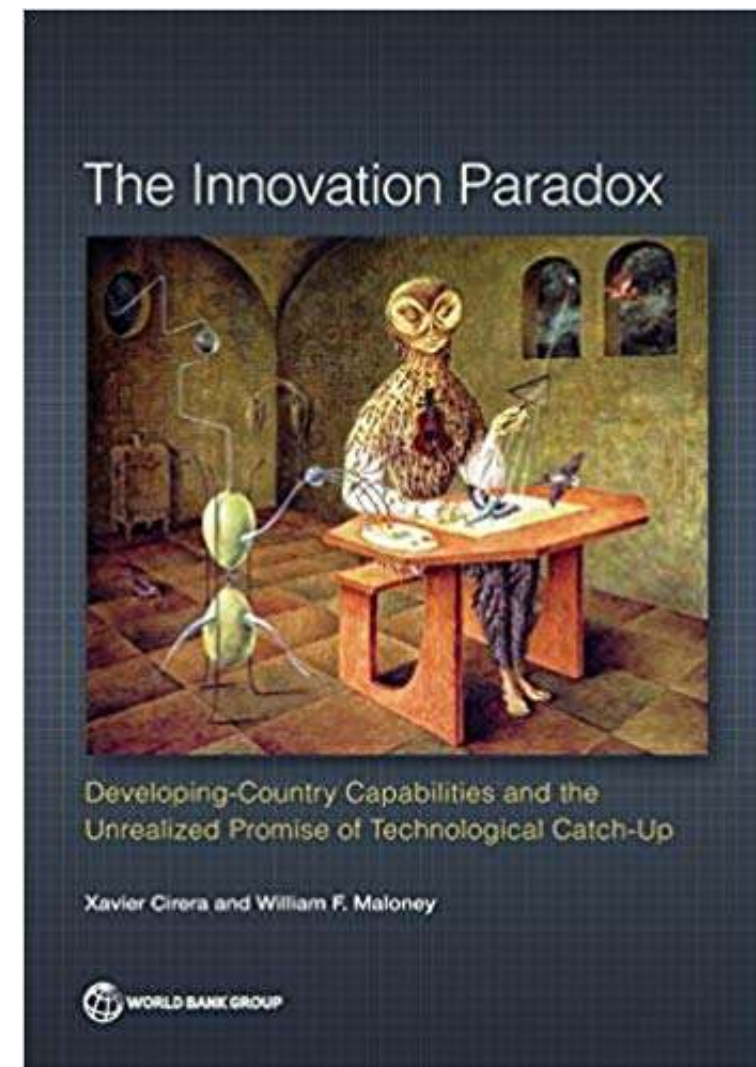
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Introduction

- Innovation is a key to economic growth

- *Innovation Paradox* (World Bank 2017): firms in developing countries invest little in innovation
  - ✓ Innovation in developing countries means <u>technology borrowing</u>, not technology development

- Firms lack firm capabilities, particularly managerial capability

The Innovation Paradox

Developing-Country Capabilities and the Unrealized Promise of Technological Catch-Up

Xavier Cirera and William F. Maloney

WORLD BANK GROUP

Introduction (cont.)

- Management quality tends to be poor in developing countries
  - ✓ Bloom and van Reenen (2007 QJE), McKenzie and Woodruff (2017 MS)
- Positive correlation between management and innovation (U.S. census data)
  - ✓ Bloom, Brynjolfsson et al. (2019 AER)
- -> <u>Does improved management lead to innovation in developing countries?</u>

Two challenges:
- ✓ Short evaluation period: weakness of RCT
- ✓ Measurement: no R&D or patent application

What We Do and Find

- RCT of management training for Vietnamese small manufacturers in 2010
- Focus on industrial clusters -> innovation observed
- Repeated follow-up survey in 2011, 2013, and 2016

Findings

5 years after the training, treated enterprises are
- better managed
- more likely to have succeeded in innovation
-> higher survival rate and business performance

Outline

Experimental design
- ✓ Study site
- ✓ Timeline
- ✓ Intervention

(Empirical specification)

Results

Study Site

- Over 2,000 village-based industrial clusters have contributed to economic growth after Doi moi (economic reform) [Oostendorp et al., 2009 WD]

- We focus on two industrial clusters in the suburb of Hanoi: knitwear and construction steel

- We have benchmark information collected by repeated visits and surveys [Nam et al., 2009 JDS; 2010 JCE]

Basic statistics

	Garment	Steel
N	159	153
Years of education	8.1	6.8
Past training experience [=1 if yes]	0.13	0.03
Gender [=1 if female]	0.57	0.35
Baseline real sales revenue [1,000 USD]	259 [113]	1,767 [1,197]
Baseline real value added [1,000 USD]	75 [29]	114 [69]
Baseline number of employees	18 [8]	20 [19]

Timeline

- Baseline survey (2010 Jun.)
- Classroom training (2010 Jun. - Sep.)
- On-site training (2010 Dec. - 2011 Feb.)

- 1st follow-up survey (2011 Apr.)
- 2nd follow-up survey (2013 Jan.) [Higuchi et al., 2015 JEBO]
- 3rd follow-up survey (2016 Jan.)
  - ✓ Information collected also from the exit enterprises
  - ✓ Missing enterprises was only 5 in the knitwear and 0 in steel cluster

Training

Classroom training

- Lectures and workshop: 40 hours
- Production management plus ILO module (entrepreneurship, marketing, and record keeping)
- 93 / 197 participated (ITT < TOT)

On-site training

- Instructors visited each enterprise: half day * several rounds
- Mostly production management
- 90 / 90 received the consultation (ITT = TOT)

Training

- Japanese expert of *Kaizen*: Japan-pioneered production management
- Local consultants with ILO's qualification

- *Kaizen*: Basis of Toyota production system and origin of lean manufacturing
- Common-sense, low-cost, and human-friendly approach (capital investment is not necessarily required)
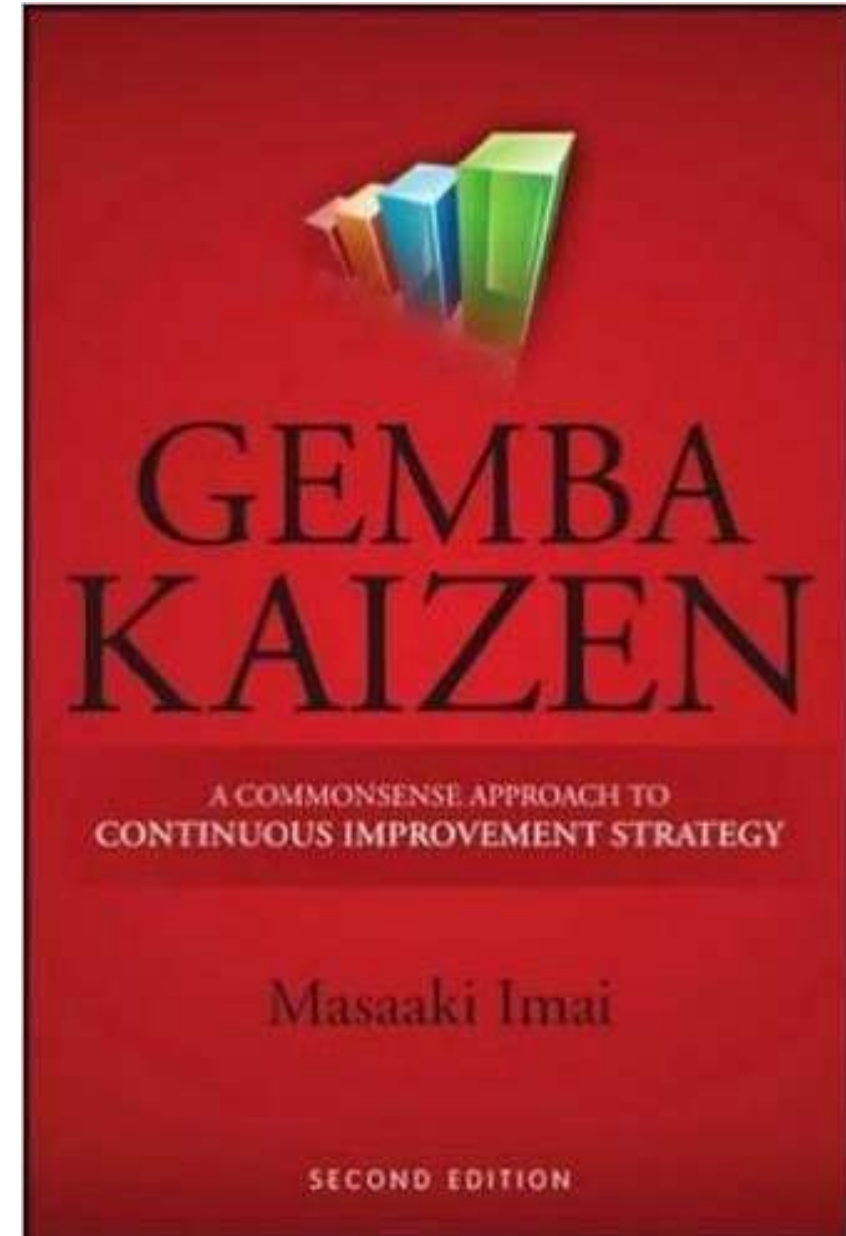
Sample Size

Group	Classroom	On-site	Knitwear	Steel
Class + Onsite	Invited	Invited	32	32
Class-only	Invited	Not	57	76
Onsite-only	Not	Invited	16	10
Control	Not	Not	54	35
Total			159	153

TABLE 2—BALANCE CHECK

	(1) Steel Class + On-site mean	(2) Steel Class-only mean	(3) Steel On-site-only mean	(4) Steel Control mean	(5) Steel (1), (2), (3) v.s. (4) p-value	(6) Knitwear Class + On-site mean	(7) Knitwear Class-only mean	(8) Knitwear On-site-only mean	(9) Knitwear Control mean	(10) Knitwear (6), (7), (8) v.s. (9) p-value
Panel A: Control variable										
Age	40.19	38.47	38.60	37.74	0.43	38.81	39.19	37.31	39.20	0.80
(as of the baseline)	(6.84)	(7.77)	(7.76)	(8.88)		(8.05)	(9.50)	(8.56)	(11.22)	
Male	0.47	0.43	0.50	0.57	0.21	0.28	0.42	0.44	0.35	0.72
(yes = 1)	(0.51)	(0.50)	(0.53)	(0.50)		(0.46)	(0.50)	(0.51)	(0.48)	
Years of education	6.81	6.79	6.20	7.17	0.43	7.75	7.98	8.63	8.50	0.32
	(2.86)	(2.60)	(2.94)	(3.25)		(2.27)	(2.88)	(3.40)	(3.21)	
Business training experience	0.03	0.01	0.10	0.03	0.92	0.16	0.14	0.25	0.06	0.06
(yes = 1)	(0.18)	(0.11)	(0.32)	(0.17)		(0.37)	(0.35)	(0.45)	(0.23)	
Panel B: Outcome variable										
Baseline *Kaizen* score	7.25	6.63	6.60	6.17	0.03	3.63	3.58	4.44	3.80	0.76
(0-11)	(1.44)	(1.45)	(1.84)	(1.46)		(1.16)	(1.28)	(2.19)	(1.28)	
Baseline management score	N.A.	N.A.	N.A.	N.A.	N.A.	13.22	12.81	15.25	13.30	1.00
	N.A.	N.A.	N.A.	N.A.		(2.72)	(2.13)	(5.11)	(2.93)	
Baseline employment size	25.19	18.70	22.70	19.37	0.59	18.09	11.74	31.75	22.41	0.33
	(15.88)	(11.88)	(18.26)	(12.43)		(30.50)	(13.97)	(48.35)	(45.58)	
Baseline sales revenue	31,509	25,757	40,529	26,316	0.67	4,094	2,783	5,697	4,340	0.40
	(23,117)	(29,649)	(39,269)	(20,369)		(3,694)	(3,323)	(7,823)	(7,150)	
Baseline value added	1,876	1,690	2,367	1,744	0.89	1,162	733	1,468	1,438	0.25
	(1,505)	(2,425)	(2,195)	(1,641)		(1,393)	(1,121)	(2,615)	(3,496)	
Joint orthogonality p-value					0.54					0.47
No. enterprises in the group	32	76	10	35	153	32	57	16	54	159

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Regression Specification

$$y_{it} = \alpha + \sum_s \beta^{BOTH}_s Z^{BOTH}_i T_{st} + \sum_s \beta^{CLASS}_s Z^{CLASS}_i T_{st}$$

$$+ \sum_s \beta^{ONSITE}_s Z^{ONSITE}_i T_{st} + \gamma y_{i0} + \sum_{n=1}^{N-1} \delta_n m_{nit} + \eta_t + \varepsilon_{it},$$

- y_{it} = outcome variable
- Z_i = 1 if invited to our training program (ITT), t = data point
- y_{i0} = baseline value of outcome variable (if available) [McKenzie, 2012 JDE]: ANCOVA specification
- m_{it} = enumerator fixed effect
- η_t = time dummy
- ε_{it} = error term clustered at the enterprise-level

- We also estimate LATE-type specification [Imbens and Angrist, 1994 ECMA]: Replace Z_i with P_i, which takes one if participated in training program and use Z_i as an instrument for P_i

Result 1: Management

Kaizen score (panel)
- Information on adopted production management practices
- Based on 11 yes/no diagnostic criteria
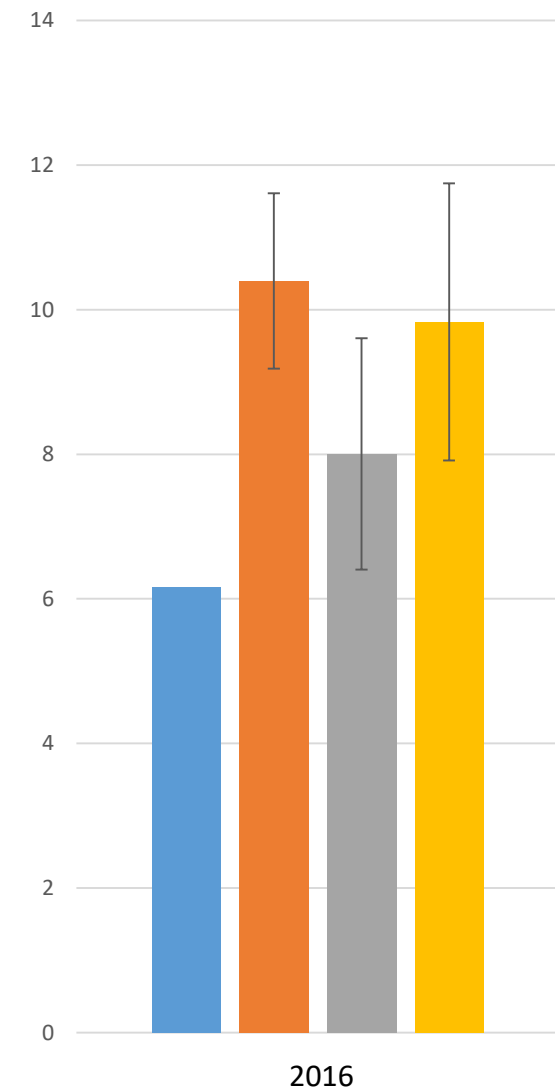- Enumerators' visual inspection and/or entrepreneurs' response

McKenzie and Woodruff (2017 MS) score (cross-section)
- Information on adopted marketing, procuring, record keeping, and financial planning practices
- Based on 26 yes/no diagnostic criteria
- Entrepreneurs' response

Kaizen score (max 11, survived only)

MW score (max 26)

Control   Onsite-only   Class-only   Both

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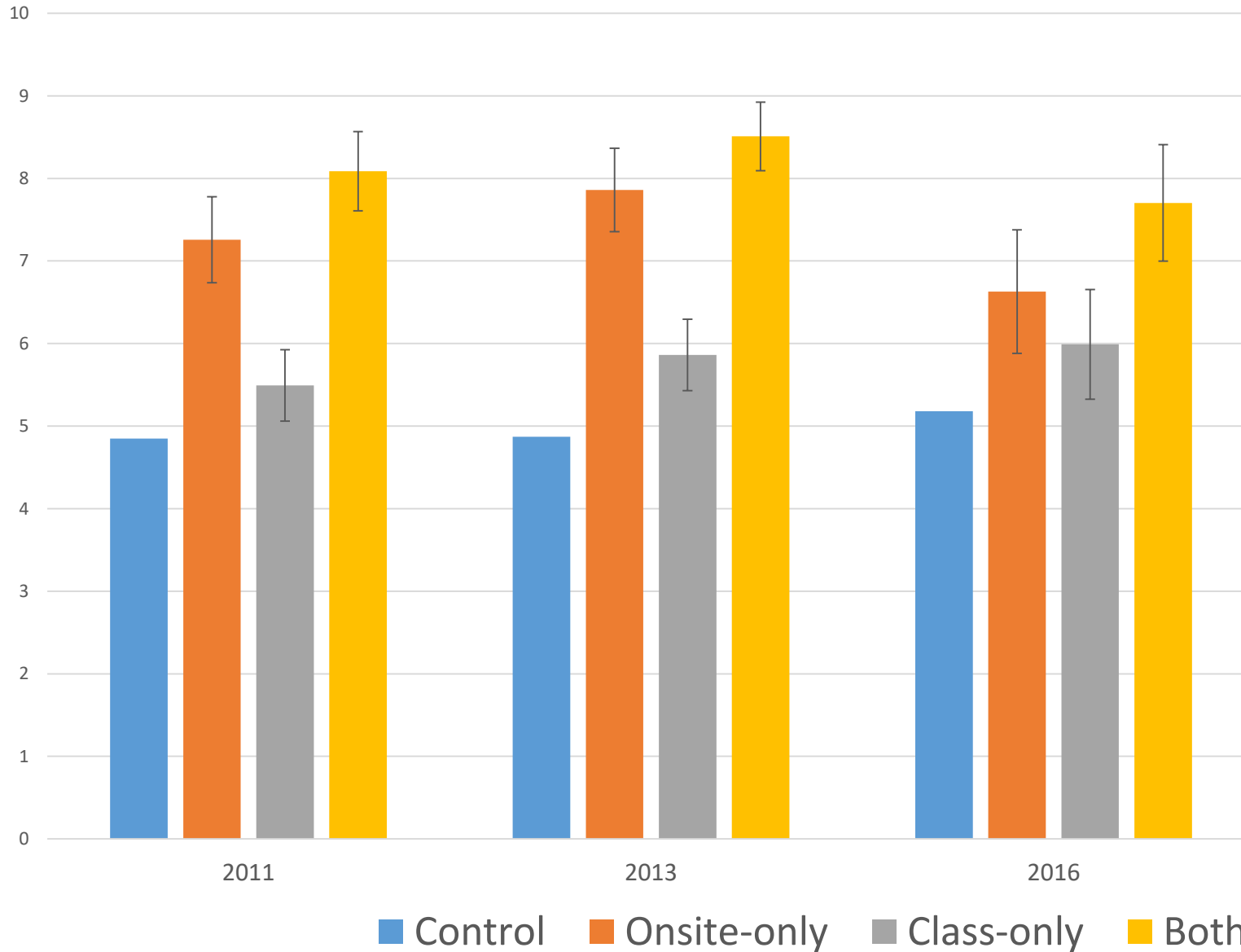
Continued learning

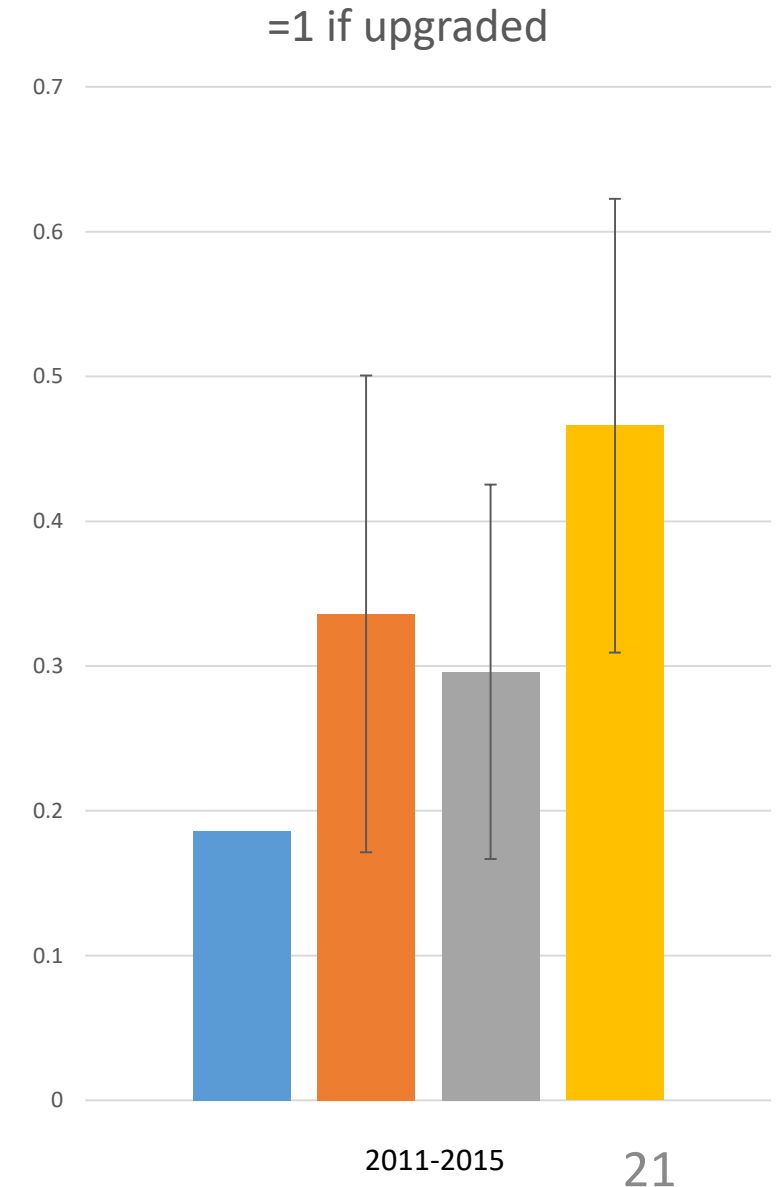|	=1 if definitely willing to learn management	=1 if participated in training (2011-2015)	=1 if invited external consultant (2015)
Class+Onsite	0.76***	0.089	0.67***
	(10.58)	(1.26)	(11.26)
Class-only	0.33***	0.034	0.14***
	(4.45)	(0.66)	(2.94)
Onsite-only	0.41***	0.22*	0.73***
	(3.74)	(1.90)	(8.87)
Training (any)	0.49***	0.11**	0.40***
	(7.63)	(2.40)	(7.29)
Control mean	0.156	0.039	0.022

Result 2: Innovation
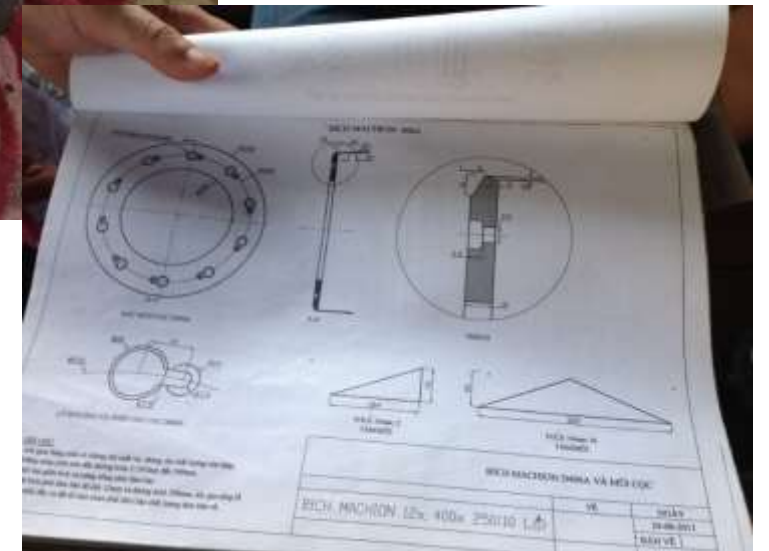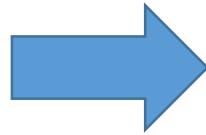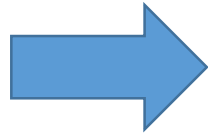
Innovation and motivation

	= 1 if introduced an upgraded product (2011-2015)	=1 if have a concrete plan to introduce new product	= 1 if confident in producing new product
Class+Onsite	0.28***	0.17***	0.38***
	(3.29)	(3.14)	(5.54)
Class-only	0.11	0.12***	0.18***
	(1.59)	(2.73)	(3.45)
Onsite-only	0.15	0.10	0.20**
	(1.29)	(1.45)	(2.08)
Training (any)	0.16**	0.13***	0.24***
	(2.57)	(3.42)	(5.09)
Control mean	0.186	0.081	0.116

=1 if upgraded

2011-2015

Price-per-weight (knitwear only)

	Change in real price per weight (2013 -2015)
Class+Onsite	0.19**
	(0.053)
Class-only	0.086
	(0.045)
Onsite-only	-0.096
	(0.042)
Control mean	-0.19

Complex relationship between management and innovation

| % change in score (from baseline to 2nd follow-up)		= 1 if upgraded	Record keeping	Sales promotion	Quality control	Marketing	Kaizen	Total
	Record keeping	0.06	1.00					
	Sales promotion	0.10	0.10	1.00				
	Quality control	-0.02	0.16	0.09	1.00			
	Marketing	0.18	0.18	0.28	0.16	1.00		
	Kaizen	0.28	0.44	0.29	0.21	0.45	1.00	
	Total	0.25	0.54	0.47	0.45	0.62	0.86	1.00

Result 3: Survival

=1 if survived
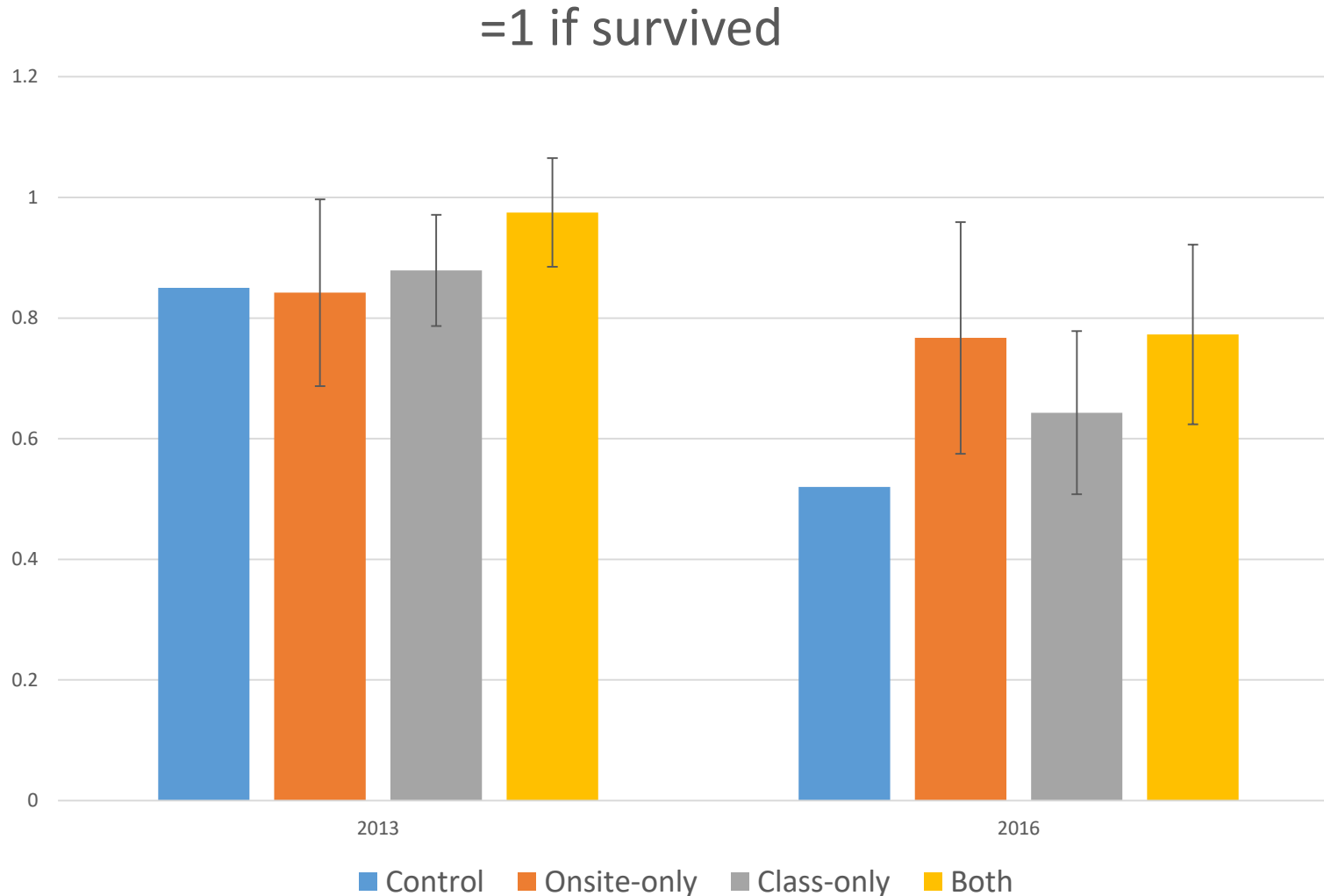
- Both had largest impacts in both clusters
- In the knitwear cluster, onsite-only had significant impacts whereas classroom-only did not
- In the steel cluster, class-only had significant impacts whereas onsite-only did not

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Result 4: Value added (1M. VND = 50 USD)

Unconditional

Conditional

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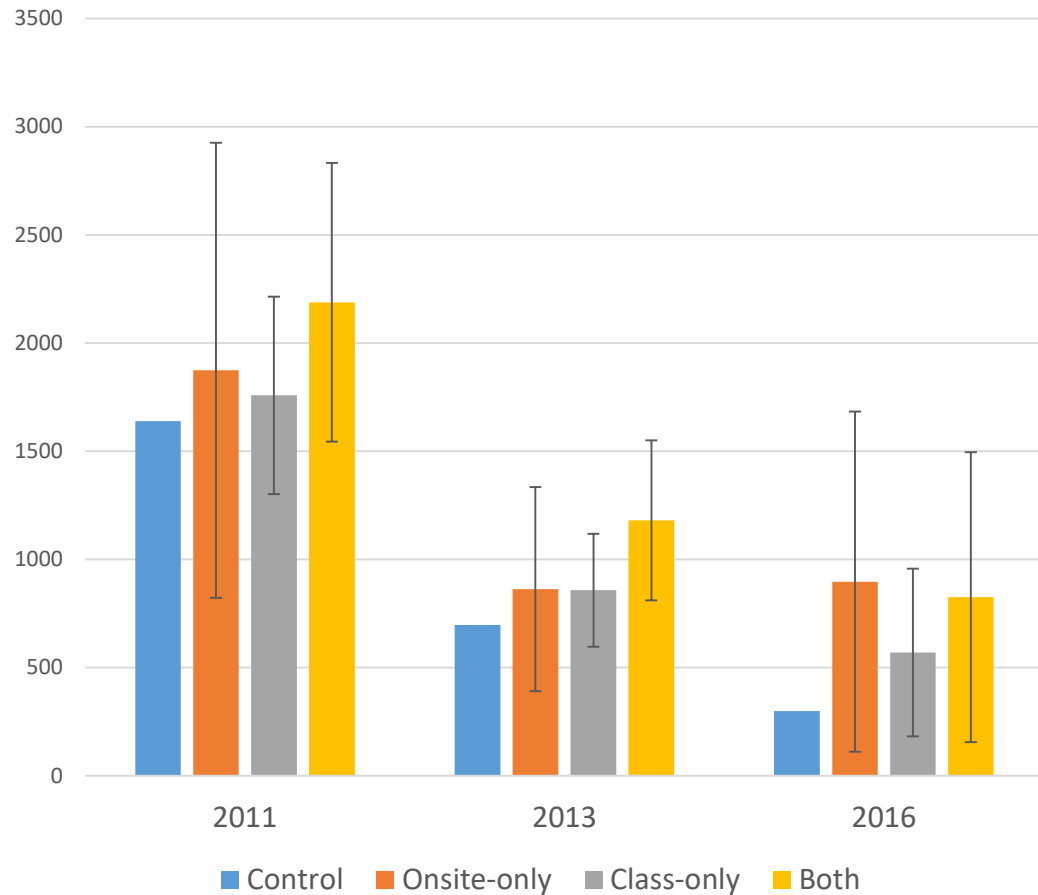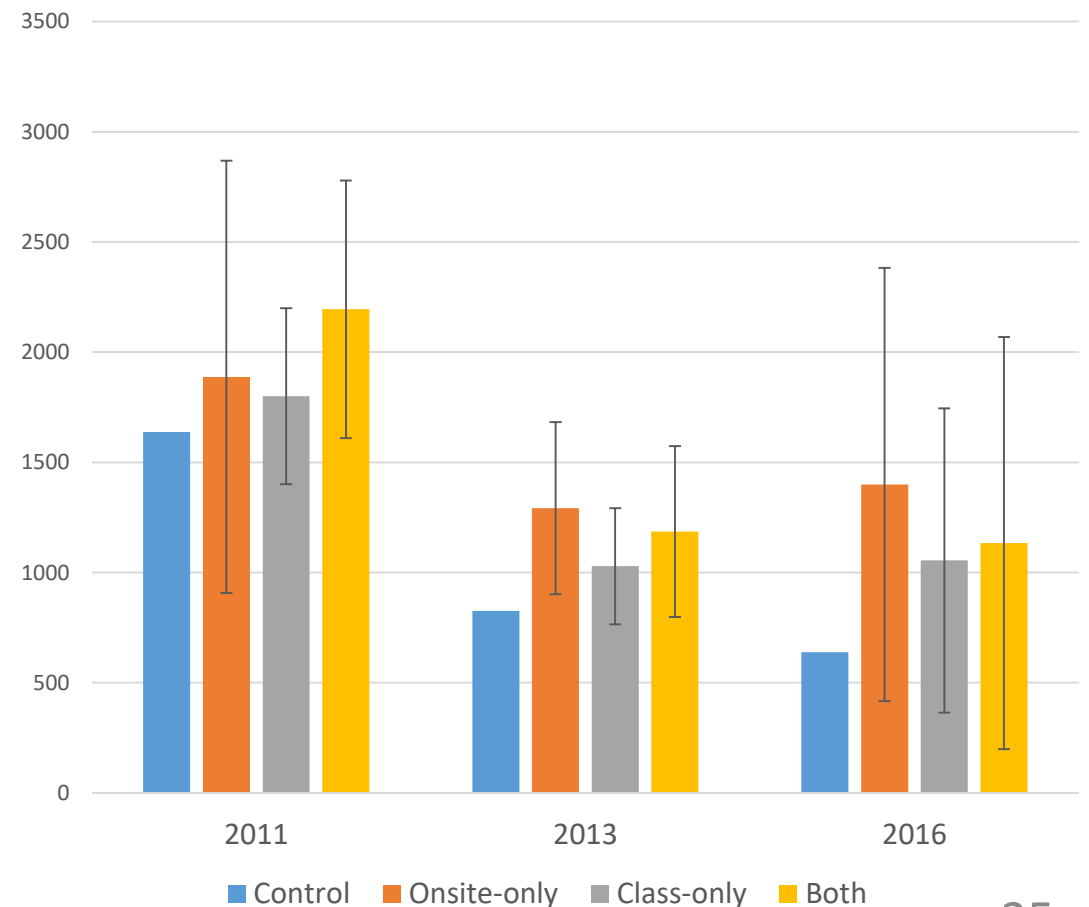
Training pooled to increase power

	Sample size	1st follow-up	2nd follow-up	3rd follow-up	*P*-value equality	*P*-value all zero
Panel B': Unconditional Value Added (in mil. VND = 50 USD)						
Training (any)	931	252.9	250.3**	381.0**	0.83	0.04
		(219.9)	(120.6)	(189.7)		
Control mean		1637.8	696.7	298.2		
Panel C': Conditional Value Added (in mil. VND = 50 USD)						
Training (any)	783	283.8	276.0**	491.2	0.81	0.06
		(196.2)	(123.0)	(330.8)		
Control mean		1637.8	826.0	637.9		

Robustness (particularly for value added)

- Inverse hyperbolic sine (log-like) transformation
- Winsorizing or trimming top 1 or 5 percent
- Controlling for record keeping score
- Randomization inference
- Multiple hypothesis testing

Summary

- Training has impacts on management, innovation, and business performance

- A simple training can be a trigger for long-term dynamics of small firms