

## APPENDIX A - Training Protocols for TDIs

### DESIGN THINKING INTERVENTION

Training of design-thinking teams was structured around Liedtka and Ogilvie (2011)'s key questions (i.e., what is, what if, what wows, and what works) and tools to do so (e.g., interviewing, brainstorming, journey mapping, prototyping, mind mapping, and value-chain analyses). In particular, we generated a protocol including the five following steps:

**Step1 What is? Identifying the problem and its scope** (e.g., if the problem is team-based, department-based, or organization-based) and the stakeholders.

At this step, teams are to define the problem that needs solving, to understand its complexity, the stakeholders affected by it, the information needed for problem resolution and the relationship between the identified problem and team's key results. This is done by answer the following questions:

Questions asked
Why is this problem important? --describing key results of the problem
What are the expected results? --describing how the problem will be resolved
Which obstacles does the problem solution have? --which constraints would the team have to solve the problem?
How should we approach the problem? --Which approach could the team adopt to solve the problem?
Who are the stakeholders of the problem? --Identify which party should be addressed? <ul style="list-style-type: none"><li>• Stakeholder 1, those for whom the new solution serves, or those who would use the new solution. They are regarded as users of the new solution.</li><li>• Stakeholder 2, those who could help us to solve the problem. They may be the team members themselves, colleagues in other departments, or people who can make decisions in the company.</li></ul>

### **Step 2 What is? Reframing the problem**

Team members were asked to: "Share the information gathered at step1 and continue the discussion. Focus on the users of the potential solution (stakeholder 1) and analyze their real needs or "pain points". Be open and curious, don't be defensive and don't interrupt the narrative of the person involved, so you can gain a deeper understanding of their feelings and thoughts". Team members discussed and filled in the information request form as follows, and then gathered information before the next meeting, or even invited the stakeholders to join the next meeting.

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Information request form		
Which information do you need?	From whom? From which department?	How to get the information?
		Interview <input type="checkbox"/> observation <input type="checkbox"/> documents <input type="checkbox"/>
		Interview <input type="checkbox"/> observation <input type="checkbox"/> documents <input type="checkbox"/>
		Interview <input type="checkbox"/> observation <input type="checkbox"/> documents <input type="checkbox"/>

Team members were encouraged to use customer journey mapping which is a tool for identifying customer needs through design thinking. It is appropriate to use customer mapping at stage 2 to describe and distinguish customer experiences. A journey map is a detailed visualization that shows how a user-based persona is acting and feeling throughout the process of using a particular product.

Team members were also encouraged to understand "what is" by observing and/or interviewing stakeholders, trying to understand their needs. Experiences of users investigated were listed one by one so that a summary and comparison could be made. Since most people don't know what they really need, only when their needs are listed together, compared and analyzed, can the most core needs be captured and used as "opportunities" and "breakthroughs".

### ***Step 3 “What if”? - New possibilities for growth are generated***

Teams were asked to brainstorm ideas and develop concepts.

Four criteria were set up for brainstorming:

- (1) Emancipate the mind, be whimsical and unrestrained, and speak freely;
- (2) No commenting on other people's ideas during the meeting or judging after the meeting;
- (3) Use a large number of ideas to ensure high-quality and more good ideas and don't worry about the quality of the content of the ideas;
- (4) Encourage borrowing and building upon other people's ideas.

### ***Step 4 “What wows?”- Assumptions are tested and prototypes are created and refined.***

Team members were asked to: "Create testable models of the ideas generated above in order to test the assumptions you made regarding their suitability. The prototype should be incomplete to invite users to interact with and improve it. Engage stakeholders in the development of new concepts from the rough prototypes you created. Have them tell you everything that is wrong with the idea".

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**Step 5 “What works?”- Users are identified and the solution is shaped into something that can be trialed.**

Team members were asked to: "Obtain feedback from stakeholders, execute learning launches and design the on-ramp (how the solution will be offered to users). Experiment with a refined prototype where users are both interviewed and, most importantly, their actions are observed. Brainstorm solutions to the parts that failed during the previous step, revise the concept, refine key assumptions, create a higher fidelity prototype, develop ways to engage users in co-creation, let the users try it again and then gain new, final insight".

### CHECKLIST FOR A DESIGN THINKING MEETING

Team identifying number \_\_\_\_\_

Date \_\_\_\_\_ Start time \_\_\_\_\_ End time \_\_\_\_\_

Who is leading today’s discussion? \_\_\_\_\_ (please write down his/her name)

How many team members were present? \_\_\_\_\_ How many were absent? \_\_\_\_\_

What is the topic of discussion today? \_\_\_\_\_

--How many times have you discussed this topic before? \_\_\_\_\_

In today's session, were the following steps followed?

Step1 "choose a problem and discuss the scope of the potential problem"

(Please discuss “Why is this problem important? What are the obstacles to solving this problem? Which issues should and should not be included in this problem? What should we do to solve this problem? Who are the stakeholders of this problem?”)

Yes ☐ No ☐

If you choose “Yes”, please summarize what you discussed.

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Step 2 "Redefine the problem" (What is)

(Please compare characteristics, needs, and experiences, identify core needs, and redefine the problem as “How to implement/satisfy the needs of stakeholders by.....?”)

Yes ☐ No ☐

If you choose “Yes”, please summarize what you discussed.

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Step 3 Consider possible solutions to the problem (What if)

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(Brainstorm as many ideas as possible on the redefined question "How to achieve/satisfy the needs of ..."; use mind maps to connect and categorize these ideas to find the "best" ones)

Yes ☐ No ☐

If you choose "Yes", please summarize what you have discussed.

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### Step 4 Form of the prototype of the plan (What woos)

(Based on the most "brilliant" ideas from step 3, form a prototype of the plan, which does not have to be complete, but should have certain details so that it can be evaluated or tested)

Yes ☐ No ☐

If you choose "Yes", please summarize what you have discussed.

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### Step 5 Accept feedback and make the plan work (What works)

(Hand over the prototype of the proposal to the stakeholders, listen to their opinions, get feedback and form new ideas for improving the proposal)

Yes ☐ No ☐

If you choose "Yes", please summarize what you have discussed.

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## **AFTER-ACTION REVIEW (AAR) INTERVENTION**

We refer to a procedure applied by Chen et al. (2018) for team reflexivity in a similar organizational context (i.e., manufacturing organizations). The procedure was originally created on the basis of an After-action debriefing model (Ellis & Davidi, 2005; Vashdi et al., 2013; Keiser & Arthur 2021). As in Chen et al., (2018) the team AAR process used in the current study was structured and self- (not facilitator-) led, conditions identified as preferable in Keiser and Arthur's (2021) meta-analysis. Team members were told to review events that occurred in the last few days and then "focus on whatever number of issues or events they wished as long as these issues had to do with any of the following: team processes and cooperation, work hazards, product quality, and work and reporting processes" (Chen et al., 2018: 448).

Per the AAR protocol applied in the current study, teams were required to:

- a) Review recent team objectives (e.g., last week, last month, or last quarter);
- b) Discuss what went well in the last few working days, what facilitated meeting the team's objectives and what enabled adopting steps proposed in earlier reflexivity sessions;
- c) Discuss what did not go well or proceed according to plan, and why some team objectives may not have been met and steps left un-adopted;

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- d) Identify steps that might be taken to improve outcomes in the next few days, determining who on the team needs to do what in order to ensure the adoption of these steps, and agree upon measures that might be used to assess the degree to which the team has progressed;
- e) Summarize the lessons learned in the reflexivity session.

### CHECKLIST FOR AN AAR

Team identifying number:

Date: \_\_\_\_\_ Start time: \_\_\_\_\_ End time: \_\_\_\_\_

1. Who led today's session? \_\_\_\_\_ (Please write down the name of the leader)

2. How many team members: Attended? \_\_\_\_\_ Participated in discussion? \_\_\_\_\_

3. Please indicate whether the following were addressed today:

- Review objectives (the goals that were set for the day, week, or month) Yes ☐ No ☐
- What went well? What facilitated meeting the objectives? Yes ☐ No ☐
- What didn't go well? Why were some objective not met? Yes ☐ No ☐
- What can be improved for next time?
  - ✓ Who needs to do what when to generate improvement? Yes ☐ No ☐
  - ✓ How will we know if improvement is generated? Yes ☐ No ☐
- Summary of the lessons learnt Yes ☐ No ☐

4. Major issues discussed:

- Were follow up tasks allocated to various team members to handle? Yes ☐ No ☐
  - Were issues discussed at earlier meetings followed up in this meeting? Yes ☐ No ☐
- If yes, please record the issues
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### TEAM-BUILDING INTERVENTION

#### CHECKLIST FOR TEAM-BUILDING

Team identifying number \_\_\_\_\_

Date \_\_\_\_\_ Start time \_\_\_\_\_ End time \_\_\_\_\_

Who led today's discussion? \_\_\_\_\_

How many team members were present? \_\_\_\_\_ How many are absent? \_\_\_\_\_

What is the aim of the game? \_\_\_\_\_

Please summarize what team members learned from the game?

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### APPENDIX B – Within Team Response Rates for All Three Time Points

Team	Scope	Time 0	Time 1	Time 2
1	DT	80.0%	80.0%	80.0%
2	DT	77.8%	77.8%	77.8%
3	DT	100.0%	100.0%	100.0%
4	DT	100.0%	100.0%	100.0%
5	DT	70.0%	70.0%	70.0%
6	DT	100.0%	100.0%	100.0%
7	DT	100.0%	80.0%	80.0%
8	DT	100.0%	100.0%	100.0%
9	DT	100.0%	100.0%	100.0%
10	DT	100.0%	90.0%	90.0%
11	DT	100.0%	100.0%	100.0%
12	DT	100.0%	100.0%	100.0%
13	DT	100.0%	100.0%	100.0%
14	DT	100.0%	90.0%	90.0%
15	DT	100.0%	100.0%	100.0%
16	DT	100.0%	90.9%	90.9%
17	DT	100.0%	80.0%	80.0%
18	DT	100.0%	100.0%	100.0%
19	DT	100.0%	100.0%	100.0%
20	DT	100.0%	90.0%	90.0%
21	DT	100.0%	87.5%	87.5%
22	DT	100.0%	100.0%	100.0%
23	DT	100.0%	90.9%	90.9%
24	DT	100.0%	100.0%	100.0%
25	DT	100.0%	100.0%	100.0%
26	RE	100.0%	100.0%	100.0%
27	RE	100.0%	100.0%	100.0%
28	RE	100.0%	72.7%	72.7%
29	RE	81.8%	81.8%	81.8%
30	RE	100.0%	77.8%	77.8%
31	RE	100.0%	90.0%	90.0%
32	RE	100.0%	100.0%	100.0%
33	RE	100.0%	77.8%	77.8%
34	RE	100.0%	80.0%	80.0%
35	RE	100.0%	100.0%	100.0%
36	RE	100.0%	100.0%	100.0%
37	RE	100.0%	100.0%	100.0%
38	RE	100.0%	88.9%	88.9%
39	RE	100.0%	85.7%	85.7%
40	RE	100.0%	100.0%	100.0%
41	RE	100.0%	100.0%	100.0%
42	RE	100.0%	75.0%	75.0%
43	RE	100.0%	100.0%	100.0%

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44	RE	100.0%	100.0%	100.0%
45	RE	100.0%	100.0%	100.0%
46	RE	100.0%	100.0%	100.0%
47	RE	100.0%	91.7%	91.7%
48	RE	100.0%	100.0%	100.0%
49	RE	100.0%	100.0%	100.0%
50	RE	100.0%	92.9%	92.9%
51	RE	100.0%	100.0%	100.0%
52	RE	100.0%	100.0%	100.0%
53	RE	100.0%	66.7%	66.7%
54	RE	100.0%	100.0%	100.0%
55	RE	100.0%	86.7%	86.7%
56	RE	100.0%	100.0%	100.0%
57	RE	100.0%	81.8%	100.0%
58	RE	100.0%	100.0%	100.0%
59	RE	100.0%	100.0%	100.0%
60	RE	100.0%	100.0%	100.0%
61	RE	100.0%	100.0%	100.0%
62	RE	100.0%	100.0%	100.0%
63	RE	83.3%	83.3%	83.3%
64	RE	100.0%	100.0%	100.0%
65	RE	100.0%	100.0%	100.0%
66	RE	100.0%	100.0%	100.0%
67	TB	100.0%	100.0%	100.0%
68	TB	100.0%	100.0%	100.0%
69	TB	100.0%	90.9%	90.9%
70	TB	100.0%	100.0%	100.0%
71	TB	100.0%	100.0%	100.0%
72	TB	100.0%	100.0%	100.0%
73	TB	100.0%	100.0%	100.0%
74	TB	100.0%	100.0%	100.0%
75	TB	100.0%	100.0%	100.0%
76	TB	100.0%	100.0%	100.0%
77	TB	100.0%	100.0%	100.0%
78	TB	100.0%	100.0%	100.0%
79	TB	100.0%	100.0%	100.0%
80	TB	100.0%	100.0%	100.0%
81	TB	90.0%	90.0%	90.0%
82	TB	100.0%	100.0%	100.0%
83	TB	100.0%	100.0%	100.0%
84	TB	100.0%	100.0%	100.0%
85	TB	85.7%	71.4%	71.4%
86	TB	100.0%	87.5%	87.5%
87	TB	100.0%	100.0%	100.0%
88	TB	100.0%	100.0%	100.0%
89	TB	100.0%	100.0%	100.0%

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### Appendix C - Psychometric Details of Scales Used in the and Study, Measurement Invariance and Discriminant Validity of Endogenous Variables

Variable	Measure	# of Items	Alpha	Sample item	Scoring
Team learning climate	Maruping, & Magni (2012)	3	T0 .71 T1 .77	“My team makes its lessons learned available to all members.”	1-strongly disagree to 5-strongly agree
Team TMS specialization	Lewis (2003)	4	T0 .80 T1 .84	“Different team members are responsible for expertise in different areas.”	1-strongly disagree to 5-strongly agree
Team effectiveness	Barrick et al., (1998)	8	T1 .96 T2 .95	“Quality of work of our team.”	1-well below the comparative teams to 5-well above the comparative teams
Task variety	Hackman, & Oldham (1974)	3	T0 .72	“The job requires me to use a number of complex or high-level skills.”	1-Very inaccurate 2-Mostly inaccurate 3-Slightly inaccurate 4-Uncertain 5-Slightly accurate 6-Mostly accurate 7-Very accurate

#### Invariance and Discriminant Validity:

Prior to testing the hypothesized effects of DT (relative to AAR and the control condition) on the endogenous variables, we first tested the longitudinal measurement invariance of the two mediators and team effectiveness. The results (see Table below) support the configural, metric, and scalar invariance of these variables across the measurement occasions (Larson et al., 2020). We also conducted a confirmatory factor analysis to examine the distinctiveness of the two mediators and their distinctiveness from the team effectiveness



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measure. The results showed that the hypothesized three-factor model (team learning climate at T1, TMS at T1, and team effectiveness at T1) had a good fit,  $\chi^2(87) = 451.02$ , comparative fit index (CFI) = .955, root mean square error of approximation (RMSEA) = .077, standardized root mean residual SRMR = .029, and fit better than all two-factor alternatives (i.e., the alternative model with team learning climate and TMS merged into a single factor [ $\chi^2(89) = 835.47$ , CFI = .907, RMSEA = .108, SRMR = .053,  $\Delta\chi^2(2) = 384.45$ ,  $p < .01$ ], the alternative model with TMS and team effectiveness merged into a single factor [ $\chi^2(89) = 1624.04$ , CFI = .809, RMSEA = .155, SRMR = .132,  $\Delta\chi^2(2) = 1173.02$ ,  $p < .01$ ], and the alternative model with team learning climate and team effectiveness merged into a single factor [ $\chi^2(89) = 1208.45$ , CFI = .861, RMSEA = .133, SRMR = .113,  $\Delta\chi^2(2) = 757.43$ ,  $p < .01$ ]), and the one-factor alternative model ( $\chi^2(90) = 2218.24$ , CFI = .735, RMSEA = .182, SRMR = .150,  $\Delta\chi^2(3) = 1767.22$ ,  $p < .01$ ), which showed that the three measures capture distinct constructs. Together, these analyses underscore the strong psychometric properties and cross-time consistency of these measures.

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*Table with Longitudinal Measurement Invariance Analyses for Outcomes and Mediators<sup>1</sup>*

Model	Longitudinal invariant models	$\chi^2$	$\chi^2_c$	df	RMSEA	CFI	TLI	SRMR	$\Delta\chi^2$	$\Delta\chi^2_{df}$	$\Delta CFI$	$\Delta RMSEA$
Team performance	Model 1a: Configural invariance	203**	2.51	40	.075	.964	.949	.025	-	-	-	-
	Model 1b: Metric invariance	231**	2.25	47	.074	.959	.951	.039	13.37	7	-.005	-.001
	Model 1c: Scalar invariance	261**	2.09	54	.073	.954	.952	.038	25.34**	7	-.005	-.001
Two-factor model of mediators	Model 2a: Configural invariance	30**	1.33	26	.014	.998	.997	.017	-	-	-	-
	Model 2b: Metric invariance	36**	1.31	31	.015	.998	.997	.031	6.02	5	0	.001
	Model 2c: Scalar invariance	53**	1.28	36	.026	.992	.990	.048	18.90**	5	-.006	.011

*Note.*  $N=714$ .  $\chi^2_c$  = scaling correction factor for  $\chi^2$ .  $\Delta\chi^2$  = Satorra-Bentler scaled  $\chi^2$  difference statistic (Satorra & Bentler, 2001).  $\Delta\chi^2_{df}$  = degrees of freedom for Satorra-Bentler  $\chi^2$ .  $\Delta CFI$  and  $\Delta RMSEA$  = change in CFI and RMSEA estimates, respectively, between successive invariance models. \*  $p < .05$ . \*\*  $p < .01$ .

<sup>1</sup> We also tested measurement invariance of each construct separately. The pattern of results remained unchanged, supporting the configural, metric, and scalar invariance across the measurement occasions.

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### Appendix D – Random Coefficient Modeling Results

Variable	Team efficiency	
	<i>Est.</i>	<i>SE</i>
Intercept	.59**	.15
Time <sup>a</sup>	.28**	.06
AAR vs. DT (Dummy 1)	-.42*	.19
TB vs. DT (Dummy 2)	-.38 <sup>†</sup>	.22
Time × Dummy1	-.21**	.08
Time × Dummy2	-.19*	.09
<b><i>Residual</i></b>	1.29**	

*Note.* The unit of team efficiency is 10,000 RMB. <sup>a</sup> Time is a variable ranging from -3 to +2 representing the three months prior the intervention and then 3 months followin the 8-week intervention, with 0 representing the onset of the TDIs.

<sup>†</sup>  $p < .10$ . \*  $p < .05$ . \*\*  $p < .01$ .

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### Appendix E - Analysis with Absolute Effects (Controlling for Team Effectiveness and Efficiency at T0)

	Team Learning Climate at T1		Team TMS Specialization at T1		Team Learning Climate at T1		Team TMS Specialization at T1		Team Effectiveness at T2		Team Efficiency at T2	
	Model 1		Model 2		Model 3		Model 4		Model 6		Model 7	
	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>
Intercept	3.86**	.13	3.89**	.13	3.74**	.12	3.80**	.11	.49	.45	-7.47	6.97
DT vs. TB (Dummy 1)	.25**	.09	.42**	.08	.21*	.09	.38**	.06	-.09	.10	.39	1.08
AAR vs. TB (Dummy 2)	.09	.07	.18**	.07	.14*	.07	.22**	.07	-.06	.07	-.75	.72
Team size	-.03*	.01	-.03*	.01	-.02	.01	-.02	.01	.01	.01	-.08	.15
Task variety					-.14**	.08	-.02*	.09				
Task variety × Dummy1					.32**	.11	.16	.11				
Task variety × Dummy2					.24*	.11	.14	.11				
Team learning climate at T1									.02	.13	.35	.79
Team TMS specialization at T1									.40**	.14	2.15	1.77
Team effectiveness at T0									.44**	.09		
Team efficiency at T0											1.91	1.99
<b>Residual</b>	.09**		.08**		.08**		.07**		.08**		17.96*	

*Note.* \*  $p < .05$ . \*\*  $p < .01$ . DT = Design Thinking; AAR = After Action Reviews; TB = Team Building

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### Appendix F - Analysis with Absolute Effects (Without Controlling for Team Effectiveness and Efficiency at T0)

	Team Learning Climate at T1		Team TMS Specialization at T1		Team Learning Climate at T1		Team TMS Specialization at T1		Team Effectiveness at T2		Team Efficiency at T2	
	Model 1		Model 2		Model 3		Model 4		Model 6		Model 7	
	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>	<i>Est.</i>	<i>SE</i>
Intercept	3.86**	.13	3.89**	.13	3.74**	.12	3.80**	.11	.87	.49	−9.12	6.81
DT vs. TB (Dummy 1)	.25**	.09	.42**	.08	.21*	.09	.38**	.06	−.05	.10	.25	1.12
AAR vs. TB (Dummy 2)	.09	.07	.18**	.07	.14*	.07	.22**	.07	−.08	.07	−.80	.75
Team size	−.03*	.01	−.03*	.01	−.02	.01	−.02	.01	.01	.01	−.07	.15
Task variety					−.14**	.08	−.02*	.09				
Task variety × Dummy1					.32**	.11	.16	.11				
Task variety × Dummy2					.24*	.11	.14	.11				
Team learning climate at T1									.22 <sup>†</sup>	.13	.68	.76
Team TMS specialization at T1									.53**	.17	2.28	1.78
<b>Residual</b>	.09**		.08**		.08**		.07**		.10**		.92**	

Note. <sup>†</sup>  $p < .10$ . \*  $p < .05$ . \*\*  $p < .01$ . DT = Design Thinking; TB = Team Building; AAR = After Action Reviews

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### Appendix G - Data transparency matrix

	<b>Current Submission:</b> Design Thinking & Team Performance:	<b>Published Elsewhere:</b> Team Interdependence & Member Well-being <a href="https://doi.XXXX">https://doi.XXXX</a>
Loneliness		x
Powerlessness		x
Team interdependence		x
Social support		x
Emotional exhaustion		x
Performance approach orientation		x
Mastery approach orientation		x
Gender		x
Age		x
Managerial Position		x
Team learning climate	x	
Team TMS specialization	x	
Team effectiveness	x	
Team efficiency	x	
Team task variety	x	
Team size	x	
Team intervention (condition)	x	