Socio-Technical Integration Research

RESPONSIBLE AND INNOVATIVE SMES IN CENTRAL EUROPE
2ND PROJECT MEETING AND 2ND CAPACITY BUILDING SESSION

13-14 March 2018 – Zadar, Croatia

Erik Fisher

Train The Trainer #2, Zadar 13-14/03/2018

By the end of this STIR training, you will be able to plan, conduct, and document a 12 week STIR study with 2-4 participants.

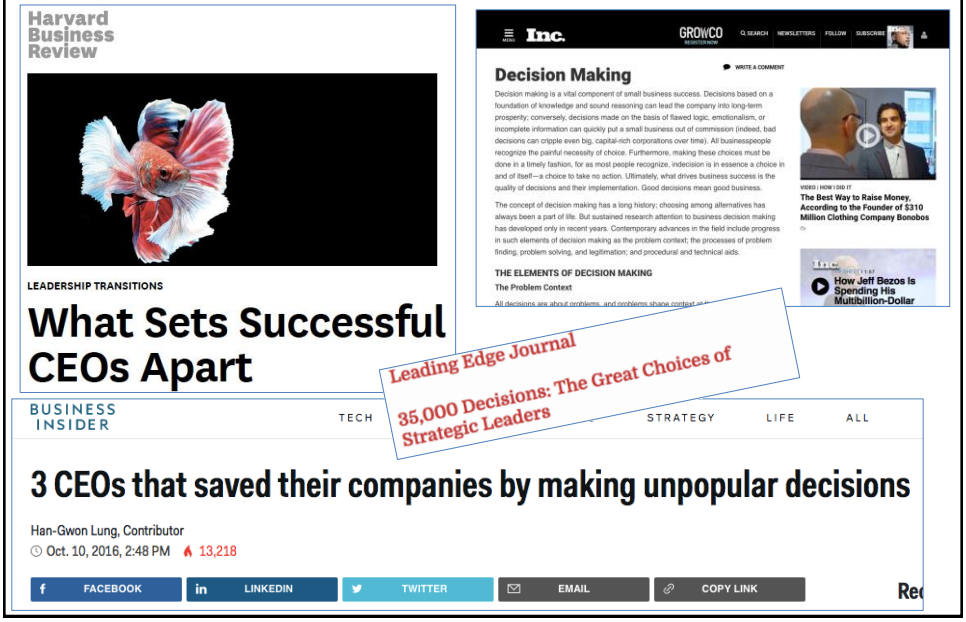
- Your report will help us answer ROSIE Project objectives of implementing responsible and innovative SMEs

STIR Phase 1 – STIR Methodology

1. 5 hours: Introducing the concept of STIR: Background and basic idea of STIR, STIR protocol questions and techniques, planning your study

0.5 hours: STIR methodology in the business sector – How does STIR work among SMEs?

Decisions



Decisions

- A commitment to a course of action
  1. Situation of uncertainty
  2. Based on the values, preferences, and beliefs of the decision-maker
  3. Choice between alternative courses of action
  4. Expected outcomes

Train The Trainer #2, Zadar 13-14/03/2018

Decisions

- A commitment to a course of action
  1. Situation of uncertainty
  2. Based on the values, preferences, and beliefs of the decision-maker
  3. Choice between alternative courses of action
  4. Expected outcomes
  5. ***Innovative***

Decisions

- A commitment to a course of action
  1. Situation of uncertainty
  2. Based on the values, preferences, and beliefs of the decision-maker
  3. Choice between alternative courses of action
  4. Expected outcomes
  5. ***Innovative***
  6. ***Responsible***

Train The Trainer #2, Zadar 13-14/03/2018

Socio-Technical Integration

"SME team members factor social responsibility into their routine decisions."

Train The Trainer #2, Zadar 13-14/03/2018

Authoritative Decisions

"Strategic"

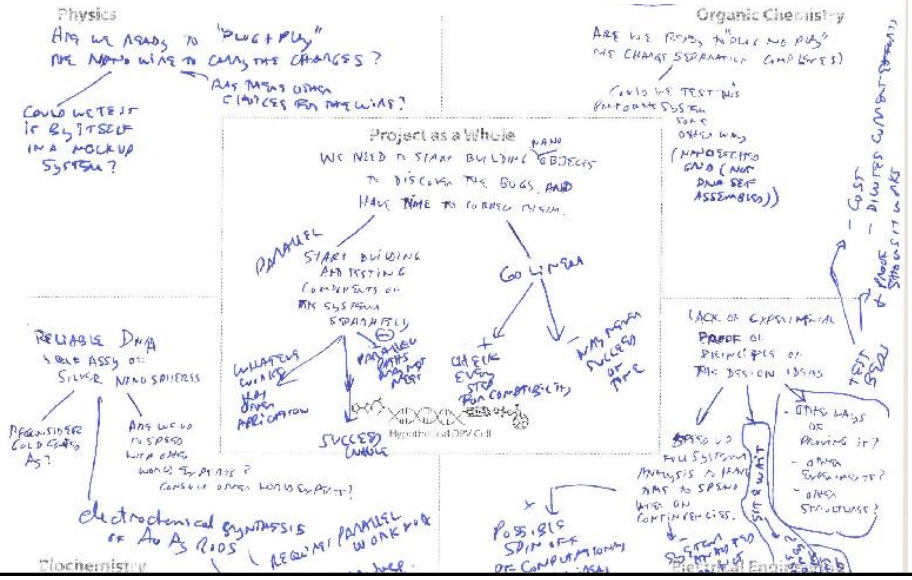
- Corporate Officers
- Investors
- Shareholders

Market Decisions
"Adoption"
- Consumers
- Users
- Regulators

Train The Trainer #2, Zadar 13-14/03/2018

Routine Decisions
"Tactical"
- Managers
- Researchers, Designers
- Manufacturers
- Marketers
- Analysts, Consultants
- Team members…

Decisions

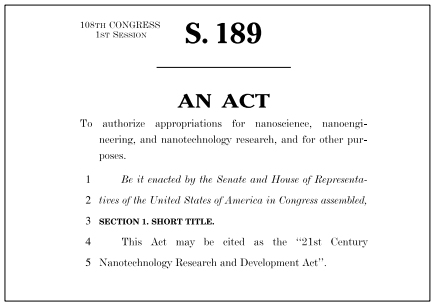


Policy Demand for Integration

- **Canada:** Integrated projects in Genome Canada (2000-2016); “economic and social goals…pursued hand in hand” (Chrétien 2001); Genome Canada.
- **United States:** federal legislation (2003); NNI (2004).
- **European Union:** “integrate societal considerations into the R&D process at an early stage” (EC 2004); RRI (2014-2017).
- **Netherlands:** NanoNed (2005); NanoNextNL (2010); RI (2014).
- **Flanders, Belgium:** NanoSoc (2008)
- **Norway:** NanoMat, etc. (2010, 2012); RI (2015, 2016).
- **United Kingdom:** EPSRC (2014), Synthetic Biology (2014).

Policy Demands for Integration

US Nanotechnology Legislation



108TH CONGRESS
1ST SESSION

S. 189

AN ACT

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

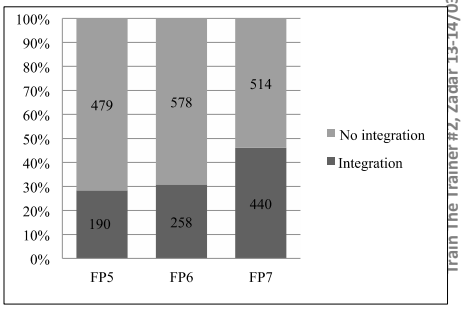
SECTION 1. SHORT TITLE.

This Act may be cited as the "21st Century Nanotechnology Research and Development Act".

US law requires "integrating research on societal…concerns with…research and development" (Congress 2003) and social research that "influences the direction of ongoing nanotechnology research and development" (HSC 2003).

(Fisher, 2005)

European FP solicitations



EU policy discourse for the "harmonious societal integration of new scientific and technological knowledge" (EU 2007) results in "an overall increase in solicitations for integration" which "become significantly more pervasive" over time.

(Rodriguez et al., 2013)

Train The Trainer #2, Zadar 13-14/03/2018

Perceived Challenges of Socio-Technical Integration

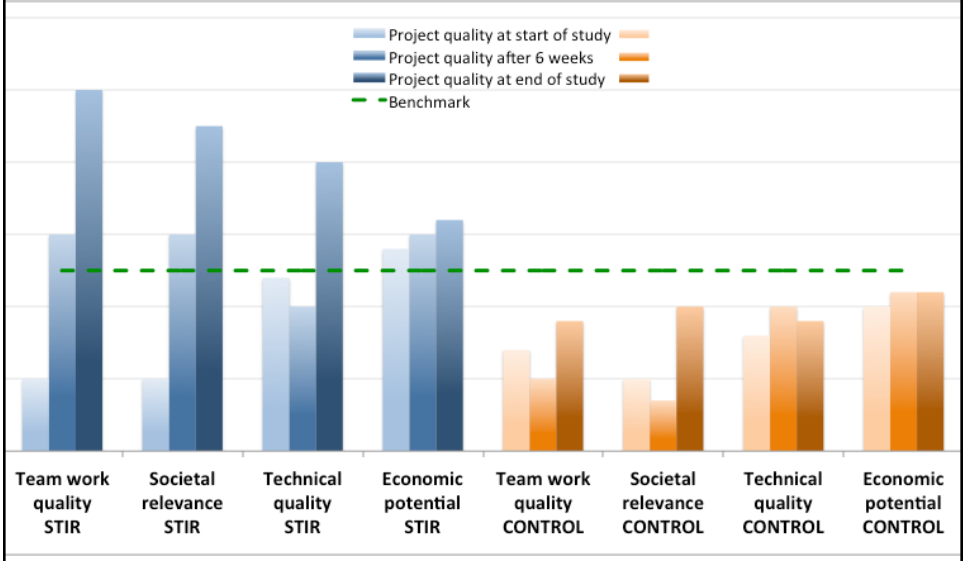
- "I don't have time to reflect…"
- "It's not part of my job…"
- "It will be a distraction…"
- "I don't have the expertise…"
- "There is too much uncertainty…"
- "It's not interesting…"
- "I will not e rewarded…"
- "Our competitors will get ahead of us…"

Perceived Challenges of Socio-Technical Integration

- t1 – Innovators are skeptical about the value of reflecting on their everyday decisions
- t2 – Innovators discover value in reflecting on their everyday decisions

Train The Trainer #2, Zadar 13-14/03/2018

Socio-Technical Integration Value



(Flipse et al. 2014)

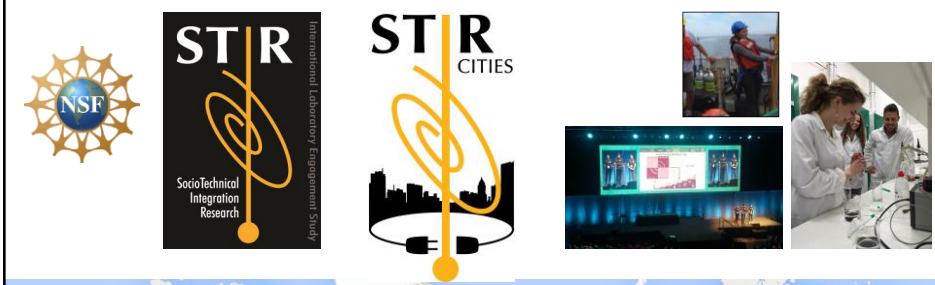
Short Exercise (5 minutes)

- Identify one “everyday” decision in your SME
- List 2-3 possible alternatives
- What are some social, cultural, ethical, or environmental values?
- Who in society might care which alternative you chose?

Train The Trainer #2, Zadar 13-14/03/2018

Socio-Technical Integration Research

Understand the possibility and utility of socio-technical integration as a form of responsible innovation



Socio-Technical Integration Research

- 12 week studies

- Midstream modulation
- Embedded humanist
- Decision protocol

- Observation, analysis, report writing

Train The Trainer #2, Zadar 13-14/03/2018

Socio-Technical Integration Research

- 12 week studies

- **Midstream modulation**
- **Embedded humanist**
- **Decision protocol**

- Observation, analysis, report writing

Midstream Modulation

- *De facto* modulation
  - Innovation decisions involve human, social, and material aspects

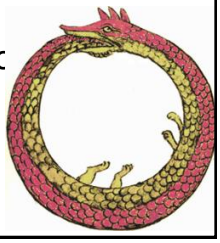
Train The Trainer #2, Zadar 13-14/03/2018

Midstream Modulation

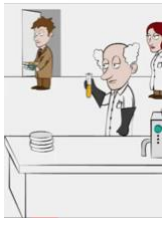
- *De facto* modulation
  - Innovation decisions involve human, social, and material aspects
- *Reflexive* modulation
  - Innovators become more aware of *de facto* modulation

Midstream Modulation

- *De facto* modulation
  - Innovation decisions involve human, social, and material aspects
- *Reflexive* modulation
  - Innovators become more aware of *de facto* modulation
- *Deliberate* modulation
  - Innovators use insights from *reflexive* mo to alter their practices
    - **First-order (means)**
    - **Second-order (ends)**



Embedded Humanist



Embedded Humanist Roles

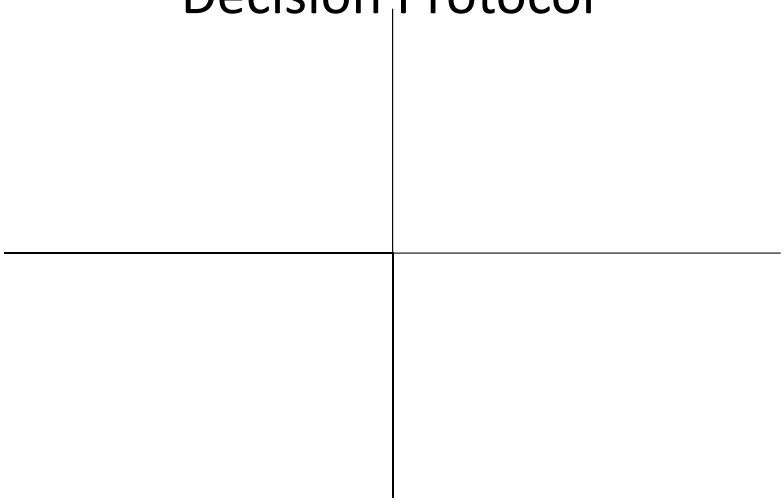
- Become embedded
  - Become a member of the team
  - Understand the decisions the team members are making
- Help team members reflect on their decisions
  - Daily or weekly
  - Use the STIR protocol
  - Listen, ask questions, provide feedback
  - Follow the project as it evolves
  - Perform the 3 MM tasks
- Keep track of the results
- Write a report

Decision Protocol

OPPORTUNITY Perceived state of affairs eliciting a response	**CONSIDERATIONS** Selection criteria that potentially influence the response
OUTCOMES Effects of selecting alternatives in light of considerations	**ALTERNATIVES** Perceived available courses of action

Opportunity Considerations

Decision Protocol



Outcomes Alternatives

Opportunity Considerations

What are you doing? *Why are you doing it?*

Perceived state of affairs eliciting a response

Criteria and conditions that can influence the response

Identify decisions

Expand aspects and values

Anticipate outcomes

Expand options

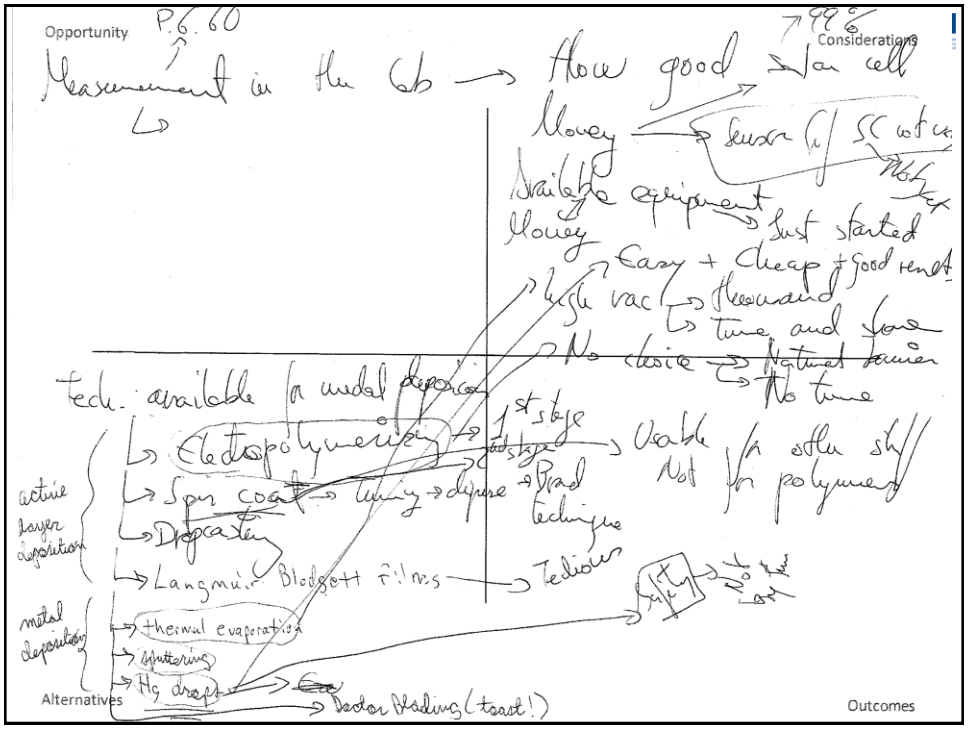
Effects of selecting alternatives in light of considerations

Perceived available courses of action

What will you do? What might happen? Who might care?

How could you do it?

Outcomes Alternatives



Interreg CENTRAL EUROPE
ROSIE

! " " # $ %& ()* ! + ", #)! " ", & ! . & $)/ 0)" 1 / . / - / ,)

- -! -*: ! C(<-! K: : -(;) ! L (-*! Z V-! -*: ! %$ -$ E$ B L F <!
' : -$ <% E-(c: B& F%&B: H! -$! F! H E(<($; ! Z V! K F H ! %: c($9 <B&-! N(<!
%$ Q E-!(; c$ B: <!E F a$; !; F; $ -0a: !T# [? U<&; -*: <(<(; !F!# *: K(E F B
h F%$' !_ : %$ <(-($; !' : F E-$' >!] : C$' : !a:) (; ; (;) !F; !: J %' (K: ; -!-*: !
' : F E-$' ! K 9 <-! a: ! -: <-: H C$' ! %$%' ! F(' ! %: <<9' : ! F; H C$' ! B F e <>!
_ 9' (;) !*(<!C(<-!H-D K K &!' 9; -!Z V!H(<E$ c: ' : H!F!B F e !(; !-*: !' : F E-$' >!
'

( )) *+,- . /,01! ? *: !' : F E-$' ! E$ 9 B H!; $ -! F E*(: c: !-*: !H <(' : H!F(' !
%: <<9' : ! C$' ! F; ! : J %' (K: ; -!! -*(<! %$ a B K ! L F <! -F E: H! -$! F!
E F E e ! (; ! -*: ! E & <-F B -0a: ! 9 < H! -$! : ; E F < ! E F -F B& <-! F; H!
<9a <-F F-: !<F K %B <>!
!
2 3 4 5, *+6 1! ? *: ! ; : : H C$' ! F! < F B H E*F K a: ' ! -$! K F(; -F(; ! F(' !
%: <<9' : !F; H E$; -F(; !E*: K(E F B c F%$' <>!
'
7 4 3+. 8, /9 3 6 1! Z : %B F E: !-0a: !L (-*!F!<(K(B F !$' !(H ; -(E F B$; : >!
'
(- ,5*: 3 1! f ' H ' !F!; : L !E & <-F B -0a: >!
'

- <! (; H(E F-: H-! -*: ! H E(<($; ! H(H ; $ -! (; c$ B: : ! F; & ! E$; <E($9 <!
E$; <(H ' F-($; !$ C<$ E(: -F B E$; E ' ; <-!<(; E: !; $; : !: J %B E(-B&-<*$ L !9%
F <! A < B E-$' <R! - B$ -! $; B& $; : ! F B: ' ; F-(c: ! L F <! %' E (c: H! F-! -*: !
-(K: ! -*: ! H E(<($; !L F <! K F H >!? *(<! L F <!) : ; : ' F B& C$ 9; H! -$! a: ! -*: !
E F < ! C$' ! ' : < F E*! H E(<($; <! -*F-! L : ' : ! F; F B& b: H-! F B*$ 9) *! -*: ' : !
L : ' : !: J E %($; <>!^ *F-!(<! $ C; $ -: -!*$ L : c: ' -!(<! -*F-! F! B F e !(; ! -*: !
<&<-: K ! E$ 9 B H!: F <(B& B F H -$! F; !: J %B$ <($; !$' ! -$! E$; -F K(; F-($; !$ C
-*: ! F-K $ <%*: ' : ! L (-*! # [? <! F; H! $ -*: ' ! %$ -: ; -(F B& -$ J (E! K F-: ' (F B
T0 N. ! E$; E ' ; <U! ? *9 <-! F B*$ 9) *! <$ E(: -F B E$; E ' ; <! L : ' : ! ; $ -!
: J %B E(-B& ' : E$) ; (b: H! F-! -*: ! -(K: ! -*: ! H E(<($; ! L F <! K F H -! <9 E*!
E$; <(H ' F-($; <! K F&!; $; : -*: B <<! a: !%: < ; -!(K %B E(-B&-!/ $' : $ c: ' -!
Z V! B F-: ' !' : F B b: H -*F-! F-! B F <-!$; : !$ -*: ' ! F B: ' ; F-(c: ! L F <! F c F(B F a B >!
? *9 <-! F <! < : ; !: B: L *: ' : -! -*: ! %$ -$ E$ B E F; ! %$ -: ; -(F B& <-(K 9 B F-: !
F L F : ; : <<! $ C F H H(-($; F B F B: ' ; F-(c: <! F-! F; !: F B: ' ! <-F) : >!

Train The Trainer #2, Zadar 13-14/03/2018

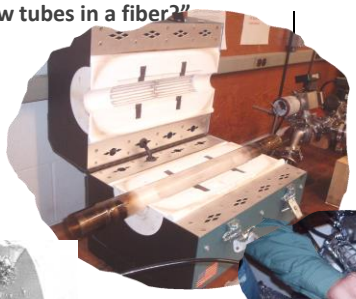
Retrospective Exercise (10 minutes)

- Make a "grid"
- Identify an important decision you made in the past
- Map the decision using the Protocol components

What was the **Opportunity**?
What were the **Considerations**?
What were the **Alternatives**?
What were the **Outcomes**?
- "What did you choose?"
- "What happened?"
- "Did anyone care?"

Opportunity Considerations

"Can we grow tubes in a fiber?"

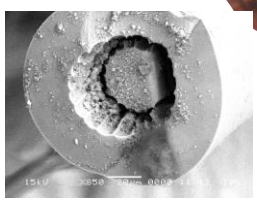


"We didn't know if it had any potential applications."

"Why not try it and see."

Fiber's properties, prohibitive size, experimental procedure

"Ferrocene is messy."



Ferrocene: "failed experiment"

Ferrofluid: "Now it's actually turning out to be something"

"I can only

"Maybe ferrofluid"

"then we wouldn't need to use Ferrocene"

Outcomes (Fisher, 2007) Alternatives

Residual Effects

THESIS

Complete title of thesis: **Carbon Nanostructures for Thermal Applications: Synthesis and Characterization**

ABSTRACT

The suitability of carbon nanotube growth on three dimensional surfaces and its application as infrared radiation absorbers for thermal detectors, and moldable thermal contact coatings is explored in this work. Carbon nanostructure growth is demonstrated on quartz using ferrofluid as the catalyst. Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) are employed to study the internal structure of the carbon structures formed. By varying the catalyst deposition technique, nanotube growth with diameters in the range 30-70 nm and lengths up to several microns is achieved. Growth inside quartz tubes and fibers, as small as 50 μm is also demonstrated for

18 months after study concluded: “ferrofluid as the catalyst” was central to PhD thesis

Modulations

- **Learning**
  - Content
  - Reflexivity
- **Deliberation**
  - Elucidation
  - Expansion
  - Critique
- **Adjustment**
  - Material
  - Behavioral
  - Strategic
  - Symbolic

Train The Trainer #2, Zadar 13-14/03/2018

Log After Each Exercise:

1. What possibilities exist for modulation?
2. What is at stake in making a modulation?
3. What modulations occurred?
4. What factors promote or prevent modulations?

Train The Trainer #2, Zadar 13-14/03/2018

1. Opportunity

- **Perceived state of affairs eliciting a response**
- Opportunity, problem, question, decision, issue, occasion, discovery.
- **Goal:** start a conversation about a decision that has both uncertainty and importance.
- *"Please describe an issue you are working on or thinking about right now? How is your work going? What has happened since the last time we talked? What are you thinking about or trying to do?"*

2. Considerations

- **Selection criteria that can influence the response**
- Goals, values, concerns, factors, conditions, aspects.
  - Material: physical, chemical, mechanical properties; finite resources (time, space, money);
  - Social: laws, institutions, culture, group dynamics;
  - Human: ethics, values, beliefs, interests
- **Goal:** identify and expand what is at stake and what matters for different people, especially values.
- *"What is important for you to think about when responding to this opportunity? Why does your response to this opportunity matter?"*

Train The Trainer #2, Zadar 13-14/03/2018

3. Alternatives

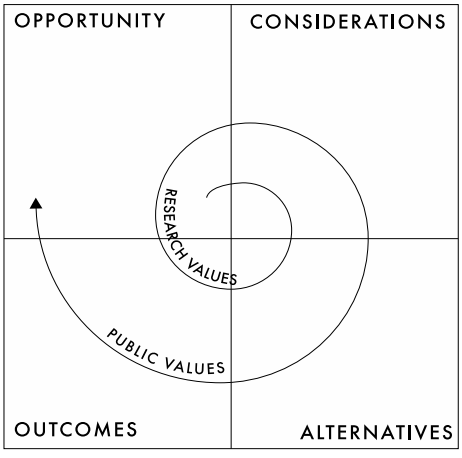
- **Perceived courses of action available for responding to the opportunity**
- Options, choices, responses, possibilities.
  - Tactical (using a different technical design)
  - Strategic (reformulating a mission statement)
- **Goal**: Identify and expand both "normal" and the "out of the box" responses, including those that might initially be ruled out.
- *"What options do you have for responding to the opportunity? Are there any other possibilities here? What else could you do? What is you chose to do nothing at all?"*

4. Outcomes

- **Effects of selecting alternatives in light of considerations**
- Developments, consequences, ramifications, effects.
- Can trigger new reflections and additional considerations and alternatives.
- Goal: explore which alternatives may have which effects, and who might be affected in the future.
  1. *What do you think you will do?*
  2. *What do you think will happen?*
  3. *Who in the future might care what you do and how you do it?*

Spiral Approach

- Move through the components in clockwise manner
- Ask about broader values, longer-term effects, more inclusive stakeholder perspectives, etc.
- Relax and try to have fun!



Applications of the Protocol

- Retrospective → Prospective

Train The Trainer #2, Zadar 13-14/03/2018

Applications of the Protocol

- Retrospective → Prospective
- Scope out many at a time → Focus on one decision at a time

Applications of the Protocol

- Retrospective → Prospective
- Scope out many at a time → Focus on one decision at a time
- Map decisions → Modulate decisions

Train The Trainer #2, Zadar 13-14/03/2018

Tips and Techniques

1. Keep it simple
2. Keep it natural (use your mother language)
3. Keep it interesting (and *fun* if possible!)
4. Iterate and cycle through the decision components
5. Listen, clarify, and repeat
6. Provide a summary at the end of each exercise
7. Link decisions over time
8. Follow-up with questions over time
   - Past protocol exercises
   - Developments in between protocol exercises

Developing your Data

- Write a "story" about each modulation
  - Narrate the events that led over time to (or that prevented) the modulation, what you and your participant talked about, why the modulation is valuable to the SME and for RI
- Verify the results
  - Your log notes
  - Your participants
  - Compare with third party accounts

Planning your study

Pre-engagement

- Chose an SME department and get to know their work
- Recruit participants
  - 1+ high-interaction (STIR 1-3 times per week)
  - 1+ controls (no STIR)

Engagement (12 weeks)

- Pre-study interviews
  - STIR exercises
  - Log entries
  - Keep track of decisions and projects over time
- Post-study interviews

Post-engagement

- Write report
- Disseminate findings and repeat

First day

- Visit the department or team
- Introduce yourself and the goals of your experiment
  - "Help SMEs become more innovative and more socially responsible in a synergistic manner"
- Ask for volunteers
  - Explain what you need (15-30 minutes for each exercise)
- Set up regular meeting times and places
- Plan or conduct the pre-study interviews
- Review your notes

Every day

- Visit the team
- Meet with your high-interaction participants
  - 15-30 minutes for each STIR exercise
  - Audio recording of each STIR exercise
  - Field notes and reflections
- Observe to learn about projects and team
- Review your notes, list modulations, write logs
  - What possibilities for modulation?
  - What is at stake?
  - What factors promote modulation?
  - What modulations occurred?

Log After Each Exercise:

1. What possibilities exist for modulation?
2. What is at stake in making a modulation?
3. What modulations occurred?
4. What factors promote or prevent modulations?

Train The Trainer #2, Zadar 13-14/03/2018

Review and Clarification Questions

Modulations

- **Learning**
  - Context
  - Reflexivity
- **Deliberation**
  - Elucidation
  - Expansion
  - Critique
- **Adjustment**
  - Material
  - Behavioral
  - Strategic
  - Symbolic

Train The Trainer #2, Zadar 13-14/03/2018

Reflexive Learning

t_1 "We don't make decisions"

t_2 "I guess this really is a decision"

Train The Trainer #2, Zadar 13-14/03/2018

Synthetic Biology

Learning

- Researchers become aware of inconsistencies in their views of the role of science in society
- They also identify new research opportunities

Deliberation & Adjustment

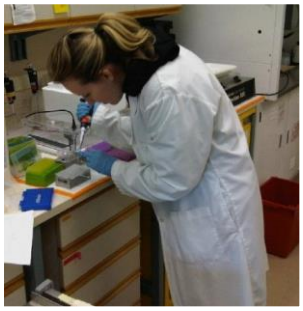
- Research group debates safety practices
- Research group alters their safety practices

(Schuurbiers 2011)

Genetics

Learning

- Social scientist conducts exemplary experiment
- Helps scientists at another lab improve their techniques



Adjustment

- Laboratory initiates public outreach

(Conley 2011)

Environmental Engineering

- Researchers debate CNT disposal techniques
  - Researchers dismiss public perceptions

Deliberation

- Issue cannot be resolved at multiple levels
  - Engineer
  - Engineer / social scientist
  - Lab group
  - National policy
  - International policy

Adjustment

- Collaborators call for policy guidance

Biophysics

Learning, Deliberation, Adjustment

"Reflections on responsible innovation generated novel ideas for antenna structures and nanoparticle synthesis"

(Fisher et al. 2010)

OPINION

CORRESPONDENCE

Research thrives on integration of natural and social sciences

Biotech Industry

Learning

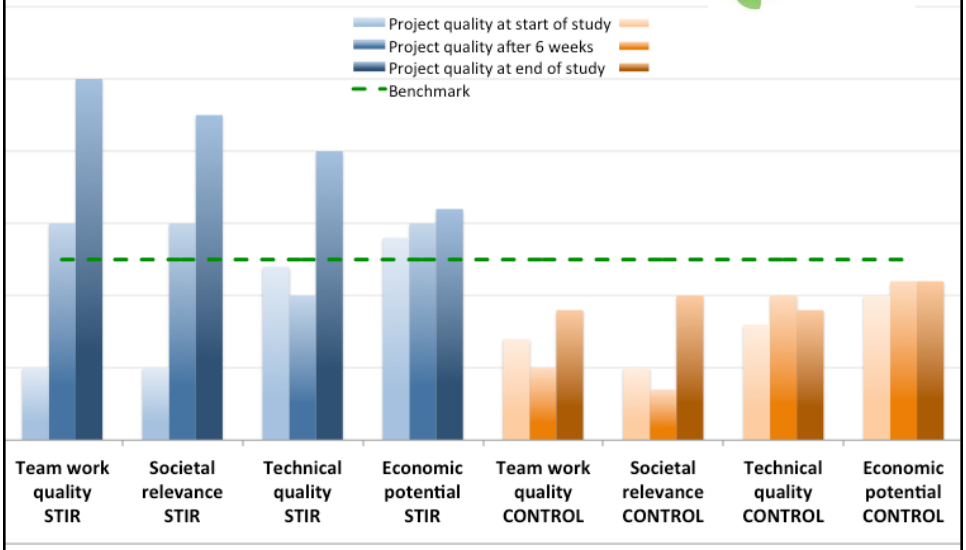
- Before: Only 1 or 5 participants (project leaders and key scientist) see integration as part of their professional duties
- After: All 5 participants come to see integration as "part of their job"

Adjustments

- Participants take actions to address sustainability, LCAs, and corporate strategy

(Flipse et al. 2013)

Biotechnology Industry



(Flipse et al. 2014)

Individual Virtues

- **Learning** **Curiosity**
  - Context
  - Reflexivity
- **Deliberation** **Care**
  - Elucidation
  - Expansion
  - Critique
- **Adjustment** **Creativity**
  - Material
  - Behavioral
  - Strategic
  - Symbolic

Interreg CENTRAL EUROPE ROSIE
Train the Trainer #2, Zadar 13-14/03/2018
International Laboratory Engagement Study
STIR Socio Technical Integration Research

Organizational Virtues

- **Learning** **Curiosity**
  - Context
  - Reflexivity
- **Deliberation** **Care**
  - Elucidation
  - Expansion
  - Critique
- **Adjustment** **Creativity**
  - Material
  - Behavioral
  - Strategic
  - Symbolic

Responsiveness
"A capacity to change shape or direction in response to stakeholder and public values and changing circumstances"

Interreg CENTRAL EUROPE ROSIE
Train the Trainer #2, Zadar 13-14/03/2018
International Laboratory Engagement Study
STIR Socio Technical Integration Research

- ***Session 6* – STIR – Phase 2: Testing the STIR Methodology**
  - Group session: practicing the application of STIR with RI Consultants. Participants work in pairs/small groups testing the STIR methodology (1.5 hours)
  - Participants report back the results of group session (1.5 hours)

Train The Trainer #2, Zadar 13-14/03/2018

Group Session

- Assemble into pairs (Partner 1 and 2)
  - Partner 1 helps partner 2 map an upcoming decision using STIR protocol (20 minutes)
  - Partner 2 helps partner 1 map an upcoming decision using STIR protocol (20 minutes)
- Assemble into new pairs (Partner 1 and 3)
  - Partner 1 helps partner 3 map a (new) upcoming decision using STIR protocol (20 minutes)
  - Partner 3 helps partner 1 map a (new) upcoming decision using STIR protocol (20 minutes)

Report Back and Feedback

- Volunteers present Grids
- Describe each component of the decision
- Identify any possibilities for modulation
- Identify any actual modulations
- Discuss techniques
  - What helped you understand your partner?
  - What helped your partner brainstorm new alternatives?
  - What helped your partner identify new or important considerations?

THANK YOU

efisher1@asu.edu

STIR is supported by the National Science Foundation under Awards #0849101 and #1535120.

Any opinions, findings and conclusions are those of the author and do not necessarily reflect the views of the National Science Foundation.