

TECHNOLOGY TRANSFER TO PRACTICE IN CYBERSECURITY WORKSHOP

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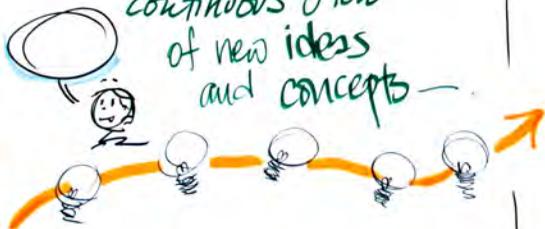
WELCOME

This is our second workshop -
the goal is to get more
NSF-funded work into
Commercial use -



A Guide for PIs -
and creating an
ecosystem for
tech transfer

Let's create a
continuous flow
of new ideas
and concepts -



THE VIEW FROM NSF

We want this to be a
discussion
and for you to
meet useful people...

* How we inform
people who come
behind us.

* Moving IT
forward

What's the best way
to incentivize PIs?

TTP at NSF
doesn't really have
a home -

accelerating TTP is a priority -
we get questions about SaTC -

Why are we
still getting
hacked?

TTP now a
SaTC supplement - has been
about 10%

next year, we don't
want TTP just added
on - we'll fund TTP-
related costs -

but we need to see a target -

We don't care who funded it originally -

Bro... CyberPhysical
Successes Systems...

BREAKOUTS: DECISION POINTS

BUSINESS

TEAMING STAFFING

CAREER

Not just start-ups!
Open source
Academy
Large companies.

Who will buy MY STUFF?

Who is my customer? Academics are needed

Few success stories

Funding: BOOTSTRAP OR OUTSIDE INVESTMENT

SW MINT Plan 10% AND

Identify the MKT outside my Univ. - PARTNERSHIPS?

Don't know the Market

Takes feet on the ground

Funding: GRANTS + INTERCOM/ CONTRACTS

VC - EARLY STAGE

Teaming

- In into the Business School
- limited skills at BOST

Teaming:

- INCUBATORS
- Tech Transfer Office
- EXPERIENCED PARTNER

- share equity TO GET EXPERIENCE

- ADVISORY PANEL

- MKTG Resource

STUDENTS:

- INTERSHIPS
- needs: 7/12-16
- High school 7, 12-16
- Pro. Dev. are NOT interested

Life vs Work

- Full Time
- Time at Univ

\$\$\$ Can mTICE you out of Tenure

- Risk: Yes, but you have to do it!

Depends on which University

- Don't CARE about PI just Univ

Understand differences b/w transfer of knowledge & trans. of tech

Open Source Community Building

Hire students not just Faculty.

PEOPLE TRANSFER

LEARN FROM EARLY ACTIONS OF SERIAL SUCCESSSES

SELECTING PARTNERS

Roles · Resources · Expertise · Relevance

Pre vs. Post Tenure Students???

Stability / parts of comm. world / diff. impressions

PI ROLES GOING FORWARD

IP POLICY

Open Source · Closed · Hybrid · PDB · Other??

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There are people who have been doing this their whole careers.

Business decisions

- Create combined COE for market assessment + coolbooks for TTP (NSF + DHS) to guide researchers w/ SME interviews, market assessment

People at what time

1. grad student + idea + basic work (paper)
2. I-corp
3. if or, TTP + MVP
4. I-corp II, paper 2
5. graduate + more compo start company = PhD?

Business Decision

- Help TTP researchers
- ① Get client needs w/ SME interview guide (simple)
- ② Get client input: MVP (minimal viable prod)
- ③ continually assess + test in market

People / At what time

1. Researcher / grad student
2. biz / MBA - market validation
3. developer 1 / 2
4. sales / marketing

Teaming

- Mixed messages
- sometimes difficult to attract great skills early on
- if the idea looks great, easy to attract great skills

Teaming

- needs to be way beyond just the University - include broader ecosystem, consortia, industry, etc.

Teaming - Staff

- need diff + skills, broad way
- technical
- business
- marketing
- operational (define)
- strategic

CAREER

Profit vs Revenue

CAREER VALUE IS University Specific

← Varies Widely But tending to revenue

CAREER

"HYBRID" CAREERS evolving - from silo-model

V DISTRIBUTION OF Profit.

UNIVERSITY SPECIFIC

← Varies widely

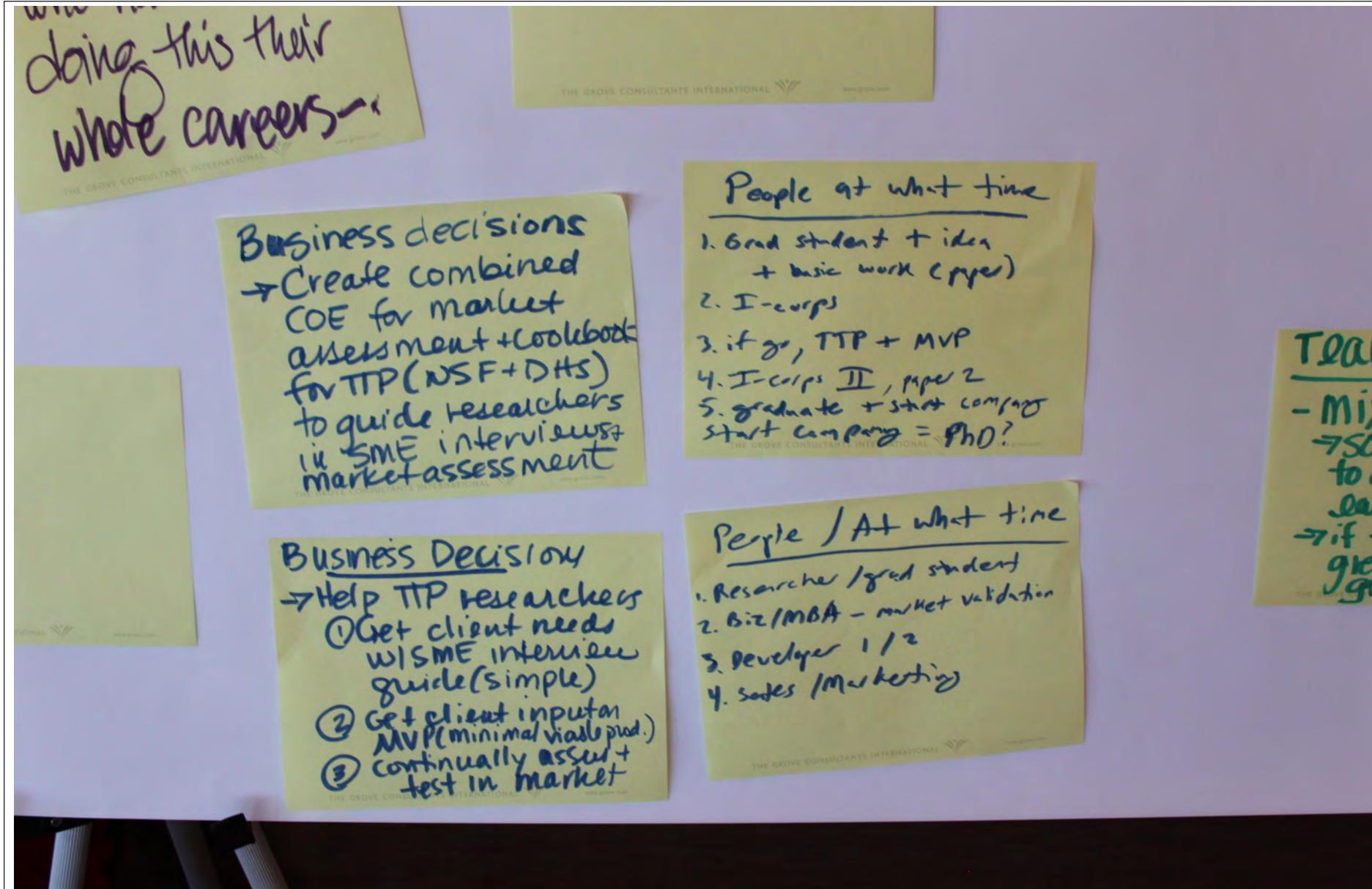
CAREER

VI. TENURE AT RISK?

- THE "DRAW" OF INVESTORS (leave academia)
- SPECIFIC RISK: DEPT/UNIV CULTURE & VALUES
- WHERE DO BUS. SKILLS COME IN?

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BREAKOUTS CLOSEUP



TRANSFERRING NSF-FUNDED RESULTS TO GOVERNMENT CLIENTS

A lot of our transfers have been informal.

- Hypervisor ^{for ARM} project - virtualization on devices - on Linux

Doing **Open source** well ~

1. Meet them ^{at LINUX conference} where they're at - Be part of the community

What do you think?

2. Get the community involved early - get their feedback - have a thick skin

3. Contribute to the community - build trust & credibility

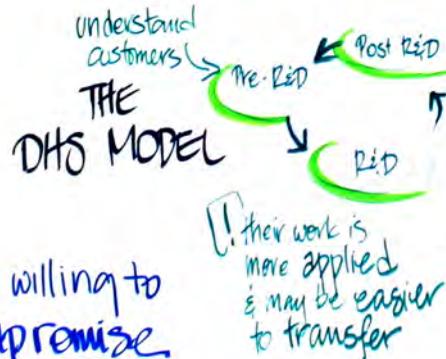
4. Get the right connections to influencers

5. Be willing to **compromise**

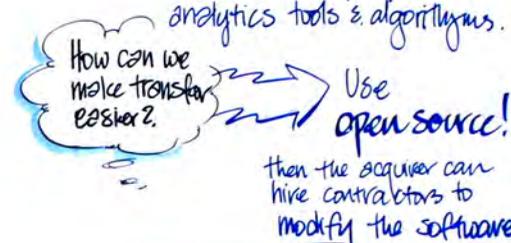
and - think about how it will be maintained -

- Worked at TIS - firewall toolkit - open source firewall
↓
product
↓
transitioned to McAfee - it wasn't easy!!

- It's rare to target govt - they're looking for commercial products - but they can make good partners -

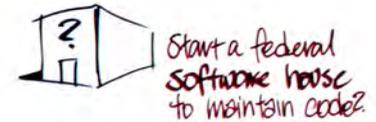


- DARPA X-data program - analytics tools & algorithms.



1. Fund the performers to do open source upfront.
2. Fund support.

Intel's able to track open source use

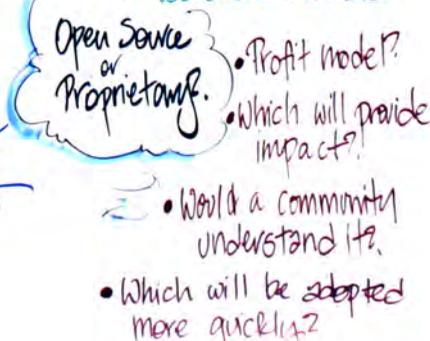


I think it's happening every day but it's not visible -

When you centralize mgmt & uniformly handle - you introduce new points of failure -

could we build a safety net so you could rescue from failed transfers?

- There may be **more transferring going on** than we're aware of - so many using **BSD** - but not talking about it - we may not have a good way of **keeping track** -



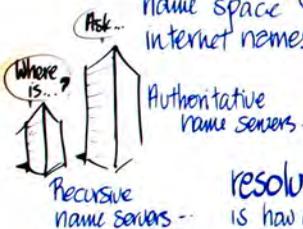
- We may have legacy products that we don't remember but could use

- Some technologies are more infrastructure -

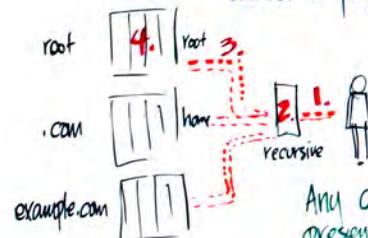
- We could use more of the lean start up process - failure is key - where the purpose is an MVP that proves a key idea

THE EVOLUTION OF DNS SECURITY

The DNS is the hierarchical, global name space for internet names.



resolution is how you use the hierarchy to answer a query.



Any connection presents a risk so does data modification. At any point, data can be modified - "cache poisoning"

RISK MITIGATIONS

1. Data handling
2. DNS-over-TLS encryption
3. qname minimization - currently researching - easy to implement - but should we
4. DNSSEC & DANE - signatures - would need incentives!



Mitigating risks - could a single PI do the research?

* Community helps. - and can magnify impact.

Quantum encryption/Computers threat - how do we prepare? would need a long-term community effort.

PRIVACY RISKS

1. browsing is visible all in one place
2. Misuse of data
3. eavesdropping on community traffic
4. Compromise & misuse



Implications in a lot world?

Yes - both naming & data integrity

SOFTWARE SUSTAINABILITY IN FEDERALLY-FUNDED PROJECTS - ACI

Software's essential for the bulk of science - but it must be sustained



PRIORITIES

- We're pushing for multi- & multi-disciplinary for a national CI infrastructure -
- Build on other NSF programs
- Lower costs
- Embed innovation in their work
- Security, trustworthiness & reproducibility
- Sustainability
- Education
- Comprehensive metrics

There's a lot of existing code we don't reuse -

We find software for 5 years - but it lasts for 20!

- Could tuition fund maintenance??
- Move it into curriculum?

This is a PUSH MODEL - and they don't work so well -

How do we assign credit? who will do it & how?

CHALLENGES

- Unstable labor force
- Idiosyncratic architectures
- Not using best practices
- Dissemination?
- How to scale?



A lot of parallels to TTP -

Yes - software dev. has to transfer to practice

TRANSFERRING NSF-FUNDED RESULTS TO ACADEMIA

I-CORPS ~..

- We adopted **lean startup** as a way to move teams quickly ^{7 hrs!} (\$50K) ~ then Go-No-Go.

to build a **fabric of innovation** for the nation.

We don't judge technologies → We judge teams!

- > 600 teams in 4 years.
- > 50% resulted in start-ups.

(App Scale)

Bio-adhesive

(Near)

Motion Savity

Microwave stethoscope

Phonocare

then we moved to include more than NSF researchers - setting up feeder programs - soon to have more than 50 sites - then created **nodes** for delivering curriculum

Entire program lead

PI

Each team Member



Discipline distribution?

- * Biotech, then computers - and



How do we do this in areas of need like software sustainability...

- * What I showed was more chosen for Congress.

The President wants you to scale this 10x!

what we're really building is a **national innovative network**

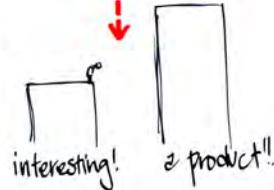
Security is always harder to sell - it's what doesn't happen!

GLOBUS

- Providing software to the non-profit research market - and our infrastructure is **awful**

SaaS is our model -

What we don't have is "Series B funding"



SBIR

- We'll look at almost anything - leading for high-risk, leading edge, transfer to commerce.

Cyber-security has had **explosive growth!** It's being seen as so critical. Work has deep academic lineage.

- We see lots of proposals from iCorps companies

We avoid companies who have a history of government contract work.



Typical team.

* People are **key**.

* Our problem is getting high quality proposals

Require a tech person to leave?

"Need one to work for the company (can be a leave of absence)"

TRANSFERRING NSF-FUNDED RESULTS TO ACADEMIA

COLLABORATIVE INNOVATION PROGRAM

Internet2

The whole program is ~~open~~ - there's an opportunity to bring together a **much broader ecosystem** -

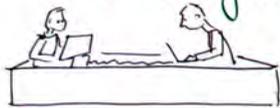
What facets?

Tactical innovations

"Go for the fences" ie P2413...

IoT sandbox ... for collaborative dev.

environments for creating innovation together...



smarter cities

genomics

right now we have a network - lemons. - we need to know what to do to leverage it.

Why cyber TPP is different...
Cyber a different kind of challenge -

Yes -

The vision of NSF is to extend this to engineering...
IoT and security realized right away they needed each other.

The risks for cyber are becoming more evident -

6.

MOTIVATING PIS TO INCLUDE TTP

transition to practice
wasn't on my radar screen
at all ~
how can we make
it more visible?

studying the
questions around
getting people to
recognize the
need to pay for
cybersecurity ~
then quantifying
risk ~

difficult for
foreign
nationals -

NSF doesn't
sponsor visas,
small companies
can't...

It's getting
almost impossible
to get!
we can,
\$1000!

??

It's confusing -
what mechanism?
when do I start
the company?

IT'S
CONFUSING

If you're concerned
about IP ownership,
SBR is better -

Where does
TTP fit?

You can protect your
source code ~

Early! We're there
to help you see if
the concept works -

And have an
early adopter
target.

Market analysis
for security tech
is extremely difficult!



Why should
we spend
the money?

Are you setting up
a fast track?
~ Yes ~

TTP may need
more curation,
monitoring...

There tend to be
complacent & hungry
PIs -- you need
the hunger to get them
to come & play

but they tend
not to have
yet been successful --
but may be
more new
culture

Agreed - it's very clear!

Investors see older
PI companies as
service companies -
& aren't interested.

we look for
structures that
are investible

we think of our
investment as
de-risking.

THE YOUNG
& HUNGRY

9 out of 10 tech
companies are
burning cash heavily ~
Twitter...
gross-revenue,
venture-backed...

\$50k only works
for teams of highly
motivated, pasta-eating
over-workers. -
there are probably
a lot.

With SBR -
it's hard to move
things around -
and it makes it hard
for the owners to end up
with more than 5%

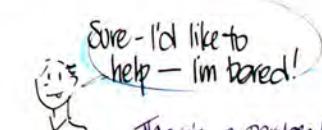
Academics tend
to want a theoretical,
publishing-focused life. -
better to find the
cool research
that they would want.

The incentives
need to be lined up -
these people need skin
in the game ~
connected to those
who have made a
billion - advisors -
and an introduction
to someone on Sand Hill Rd.

CONNECTING

Tech non-profits -
tell advisors about them,
let them choose -
but need to prep &
coach researchers on
social aspect.

Connect the
talent to someone
who can
guide them.



Sure - I'd like to
help - I'm bored!

There's a pervasive sense -
they're looking for the new ~

MEETING TTP BUSINESS NEEDS

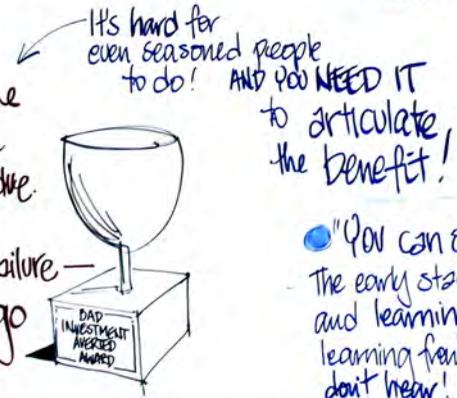
- I'd focus on coaching them on their structure - researchers suck at delegating - especially things they don't understand!
- Having people who are resilient, adaptable & smart will get you through 2 BT
- If we teach people how to evaluate the risks they're taking, they'll make better decisions

- You need to get attention - helpful from a board level
- Be willing to lower your level if it will be easier to adopt.

- "You must be the PI who founds the company" - no, but have to be clear about where the IP lies.
- "The ideas will trump execution" - Never!



- Figure out the problem you're trying to solve.
- Learn from failure - where not to go

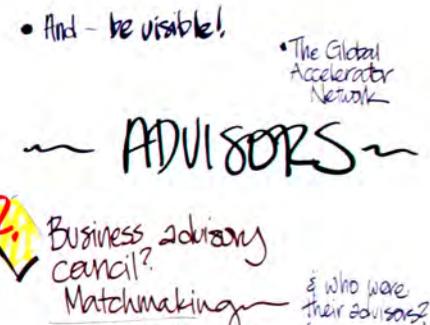


- "You can skip steps" - The early stage is listening and learning - and learning from what you don't hear!

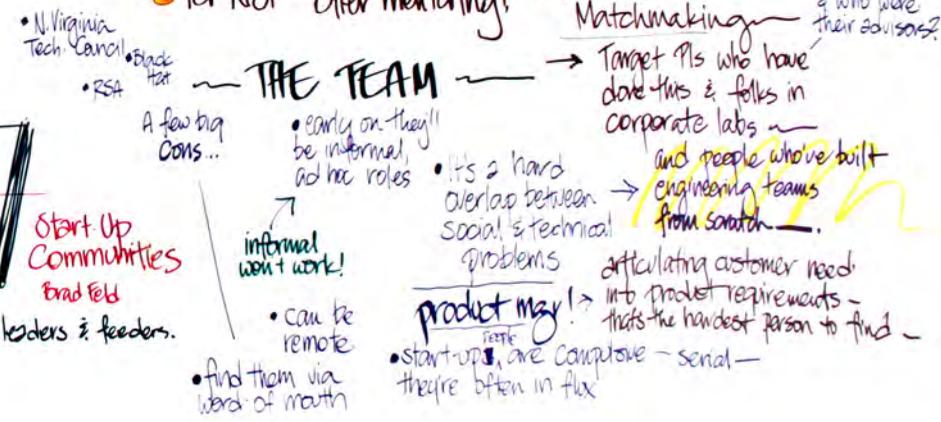
- "The government wants IP" - They actually want product.

- For TTP to academia, follow the sales cycle
- Mission Link - mentors for cos, working w/ Fed govt -

- Can't do it all alone
- Get a good marketer - join communities -
- If the VC's talking about money - run! You're looking for experience, clue, mentoring -
- For NSF - offer mentoring!



THE TEAM



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TTP MATCHMAKING

Success is:

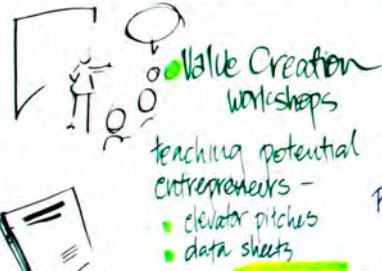
* Used across higher ed
(like ERO -)

(like ERO -)

- GRASSROOTS!
- How do we convince CIOs to adopt something new?

DHS TTP

Applied research - aim is commercialization



MAKING THE LINKS



Technology Guide

Tech Demo Days



- We don't have ecosystems - there's no infrastructure for next steps -

Dating Services?

- We have to understand the needs of customers -

Training/Evidence methodologies

- eg HIPAA in healthcare, standards... Six Sigma...

Need a "wrapper"

- Clearance makes classified work more complex when we have non-US students

GLOBUS

- Almost the entire pipeline is missing for software for science infrastructure -
- Students aren't taught how you deliver products that people can actually use

iCorps for science cyber infrastructure?

- Sustainability -
- open source doesn't work - no revenue
- Red Cap - consortium model

Long-term funding models?

- Could be NSF
- Internet? Create a market w/ links
- webinars? convenings...

Researcher Portal?

Communication Channels

Crowd-funding?

MAKE THE CONNECTIONS

create constellations!

? How do we grow our "club"?

Help w/ genomics - Maybe I can help (Internet)

- There's also the smaller effort - single PI, single grad student -

I have this idea

- need a programmer
- access to a test resource

How do I move it forward?

It will take 2 years - we're using Debate -

You need a partner who will work with you to cut the time -

incentivizing is key

- Finding the right person who will fall with you is hard

know-how time

- If NSF went to conferences, made it's suite of PIs visible - and that they authenticated

? What about Pull models?

Could start with bringing companies & researchers together - build partnerships.

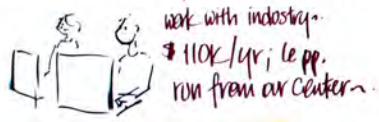
Build Partnerships

? works well for high profile PIs but..?

We do this & it's extremely effective

CLOSING THE DEAL: DELIVERING EXECUTABLE CODE

We have
Academic Software
Development Teams



- Having the students work as a team helps!
- Have students go through a software engineering class - train them properly!
- Also have to build scalable software

• Situations vary - usually, "it depends" - have to

Understand the requirements.

→ another reason for early collaboration!

• These projects are usually about proof, not sustainability.

→ We'll rebuild the code anyway - we want to see that the idea works.

But sustainability is important so that other students can continue the work!

I'm ambivalent - ... my experience is that software quality is generally abysmal - ...

• We don't know (at NSF) what the quality of the programming is - ... site visits?

quality reports? don't usually do site visits - not usually trying to move it to commercial -

they should be willing so that it's reproducible - Can't be one-size fits all - not everything needs production quality -

!! If they use a better tool set, that can solve problems up front. Some are unaware of static analysis! Ask them: What's the appropriate level for this project?

• Could make the option clear up front - could use incentives to reinforce preferred choices

10.



ECONOMIC OPTIONS FOR SOFTWARE SUSTAINABILITY

- Selling code "as is"
- Providing a service / subscription model

A challenge is people walk on ... 

- We're trying to provide support for a development step - a service they can add to their grant request

How do they know about you?
We reach out to them.

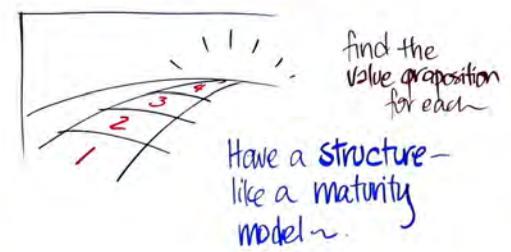
- There are different "readies" - can find low-cost programmers - industry turns to India

How do you find helpers to take you through the steps?
and help them find the helpers?

!! A lot of sustainability is whether it was built well in the first place
it's much harder & more expensive to do it later!!

!! Need good software engineers -

- Try non-cash economy --
- Get non-profits to donate \$ in exchange for access to talent.
 - Trade for development hours / personnel hours.
 - Developer conferences - sponsored by companies --
 - Donated server space



Sign us up!

At Intel --
we care about software to support our chip business --
we're interested in universities --
Some success stories --

Planet Lab → Jimi → (to developers)
We built the infrastructure at the bottom

Parallel Computing worked with MS - disseminated results to the academic community (to academia)

BIG DATA ANALYTICS (back to Intel)
We built graph builder to go with graph lab

... Shared context .. bi-directional info transfer ... long-term work.
- Each doing what they do best -
Try to set up the project from the get-go.

We don't look for ideas - we look for interesting people ~.

- * The hardest part is knowing how our innovations will perturb the ecosystem -- THAT'S worth teaching people ~
- * Fund infrastructure for sustainability
- * The problem in security is people - need to factor that in -- you have to help them do the right thing.
- * Open Source an interesting possibility
- * Use online tools for matchmaking - incentives (Pricing Authority)

SUGGESTED SOLICITATION CLAUSES

- Will support re-use of your software (eg \$5,000)
 - Emphasis on deliverable code broader impact statement
 - For infrastructure - explain how it will be sustained (process, not just economic)
 - Outreach plan
 - Support from university tech transf. office
 - Have a concrete plan - it will force them to think it through
 - Expectations of webinars
- Explain their intended use & path (provide examples?) (avoid checkboxes!)
 - Actual tasks in their work plan.

OUR TOP 5

OUR TOP 5

* Industry-oriented outreach events

* Target the idea not the PI

* Pre-screen, one-page proposals

* Inventory of current TPPs
 * catalog & data sheets
 * other TPP... potential

* Engage tech transfer offices

external volunteer resources

external advisors
 connect to other ecosystems

* Form an advisory council(s)

evaluate funding options

* Awareness training prior to submission

* On-line moderated TPP communities

* Get engaged in the TPPs

* Use conferences to connect PIs & industry

* Appreciate the many manifestations of TPP

* Provide 1st level advising - "mentoring mentors"

training & mentoring to PIs

ENABLE PUSH

* Have multiple funding dates (serial)

* Respect & exploit specialization

* Sponsor a software maintenance house

* Facilitate insight exchange
 teaching each other things

* Beware a success disaster!
 (capitalizing basic)

* Sell & encourage why they should do TPP

* Create a funnel to other programs
 SBIR, STTR, IIRRC, ICsps, DHS... IP

* A list of matchmaking opportunities

PI AWARENESS

* Provide a how-to-TPP guide

* Make more explicit recommendations to PIs

* Make explicit what problem they're trying to solve

* Funding maintenance allowances

* consider giving credit

* Understand & implement an end-to-end pipeline

* Create a resource portal

* Host PI-driven assessments of incubators etc

* Request sustainability plans

* Collaborate early & often

* Require an oral presentation

* Refine RFP solicitation incl. broader impact