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See the following paper for some of the material presented here: S. P. MacGregor, A. I. Thomson, N. P. Juster, *“Information sharing within a distributed, collaborative design process: a case study”*, in proceedings of ASME Design Engineering and Technical Conferences, Pittsburgh, Pennsylvania, September 2001.

Design for Distribution



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Development presentation

Center for Design Research, Stanford University

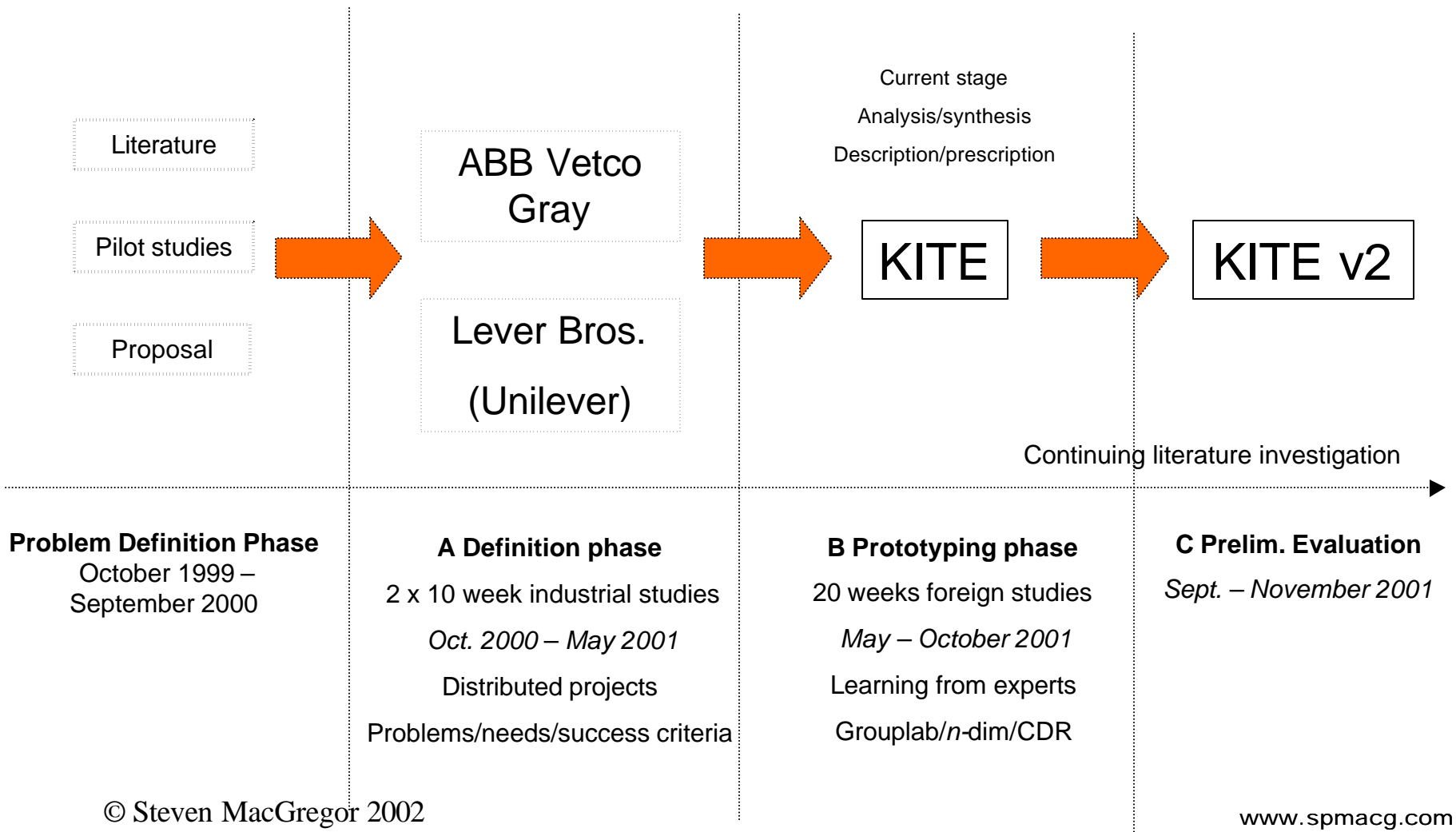
1st August 2001



○○○ Contents

- Background (PhD, tour, methodology)
- Findings
- Stanford augmentation
- Emerging hypotheses/propositions
- Avenues for exploration
- Summary/conclusion/future work

○○○ Background (PhD)



○○○ Background (PhD)

Investigating geographically distributed engineering design

Inconsistencies (problems) arise in the DDT due to isolated islands of knowledge

Distributed design does not reach its full potential due to a lack of understanding of distributed work, characteristics of successful and unsuccessful projects and a propensity to throw tools at a process not fully understood

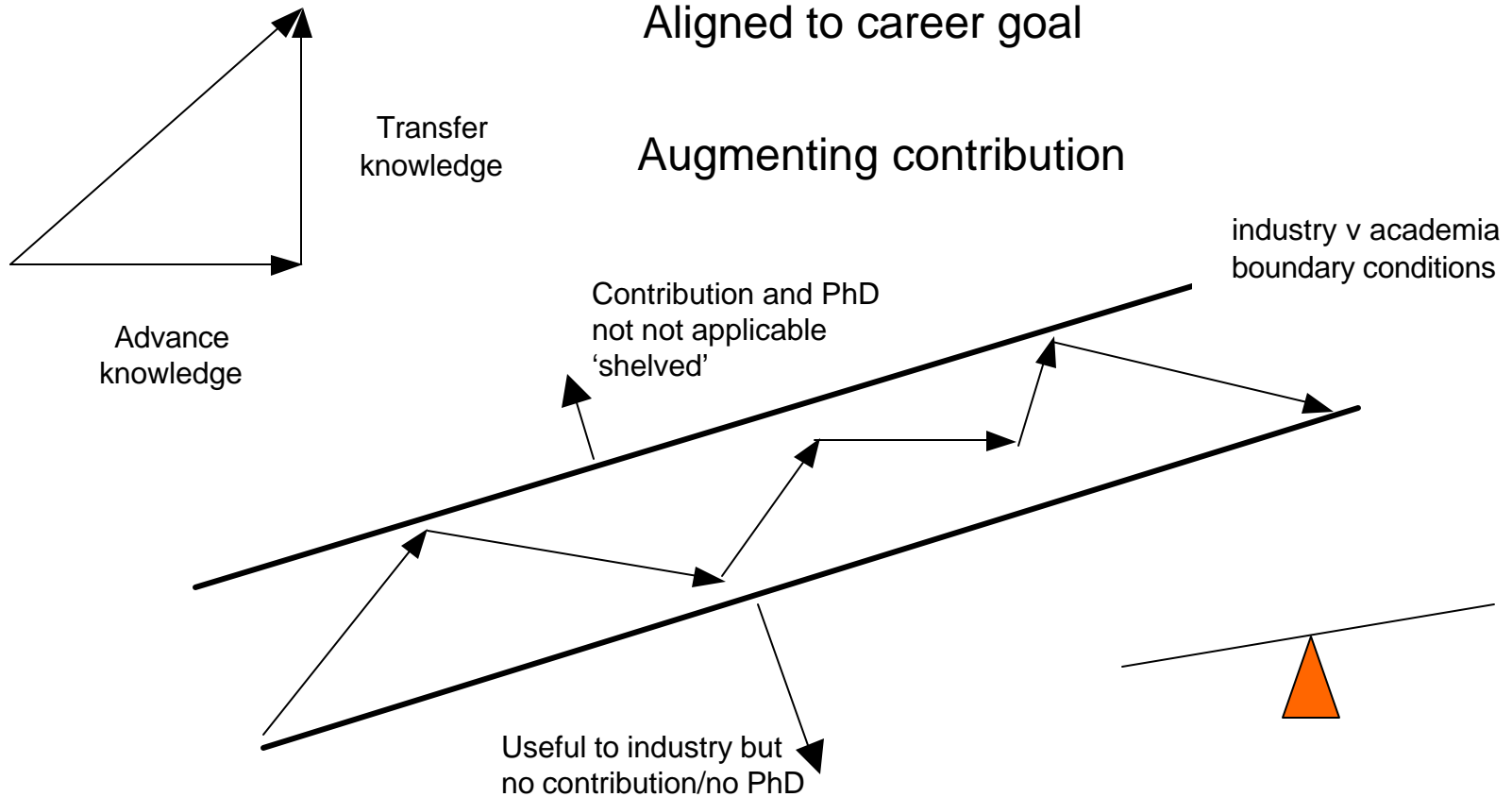
KITE (Knowledge Integration and Transfer for Engineering design)

3 year PhD based in the fields of CSCW and knowledge management



○○○ Background (PhD)

Adams PhD paradigm

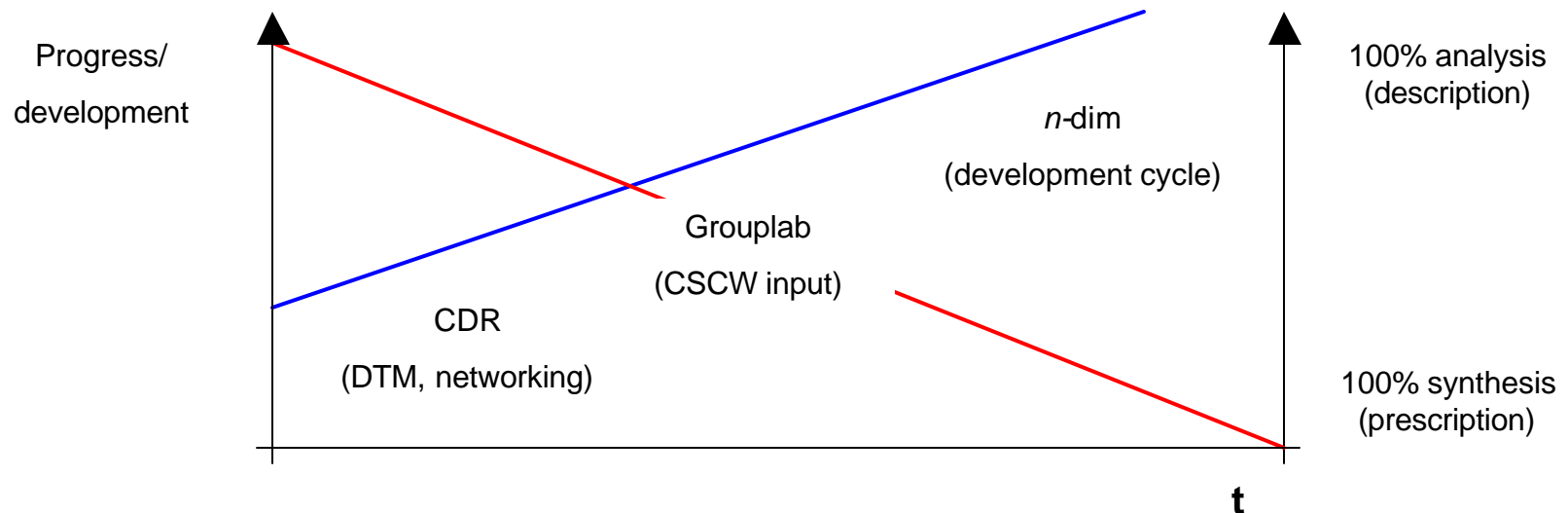


○○○ Background (tour)

Center for Design Research, Stanford (10 weeks)

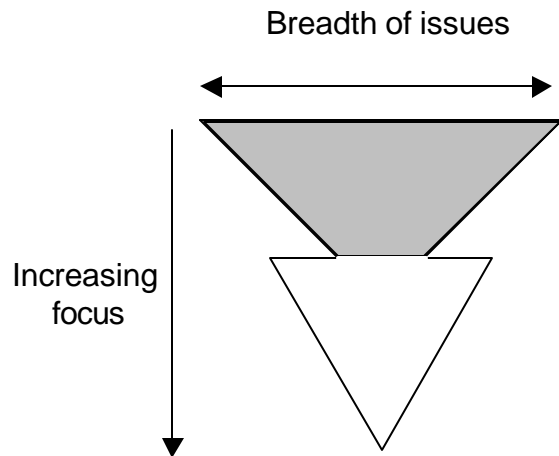
Grouplab, University of Calgary (4 weeks)

n-dim, CMU (4 weeks)



○○○ Background (case meth)

CASE 1 – 10 weeks, core team of 10 (16 in total)



Augmented by continuous observation, interpretation, and company documentation and system familiarisation

Interviews
(main case issues)

(40 off, 12 hours)

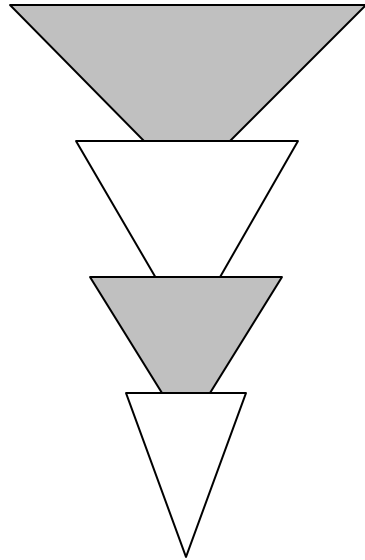
Questionnaires
(current activities, perceptions)

(24 off)

Daily diaries
(sampling distributed activity)

(174 days – 87%)

○○○ Background (x case)



Case 1

Individual case reports and cross case analysis

Satisfying detailed and general levels of PhD contribution

Adding to case study database size and diversity

Case 2

Engineering Design v Product Design

Variant Design v Original Design

○○○ Findings

INTERVIEWS (case 1)

Value of design re-use contrasting with time pressures of 100% project formalisation

Preponderance of variant (tweaking) design and concerns for future

Distributed problems

Colleagues with insufficient background knowledge

Unfamiliar terminology

Lack of visibility at worldwide sites

Sufficient information transfer but lack of rationale ('old heads')

○○○ Findings

QUESTIONNAIRES (case 1)

(case 2)

Work perceived to be:

18% distributed, 37% teamworking, 23% multidisciplinary

48%, 44%, 31%

Distribution and Knowledge

Another floor/dept. *knows more* 57% of the time

45%

Another location *knows more* 52% of the time

58%

34% of time taken up sourcing information/knowledge

40%

Most popular sources -

Company systems

Personal contact

Personal contact

○○○ Findings

QUESTIONNAIRES (case 1)

Higher level of distributed work at front end

Location of design process problems – detail design followed by specification

Point of detection – detail design

Types of design project

Original design – low incidence, high visibility, high resource allocation, high perceived problems, relatively low actual problems

Variant/adaptive design – high incidence, low visibility, low resource allocation, low perceived problems, relatively high actual problems

○○○ Findings

DIARIES

Distributed work a cyclic process of:

information sharing (ongoing, low problem rate)

collaborative design (short, intensive periods, high problem rate)

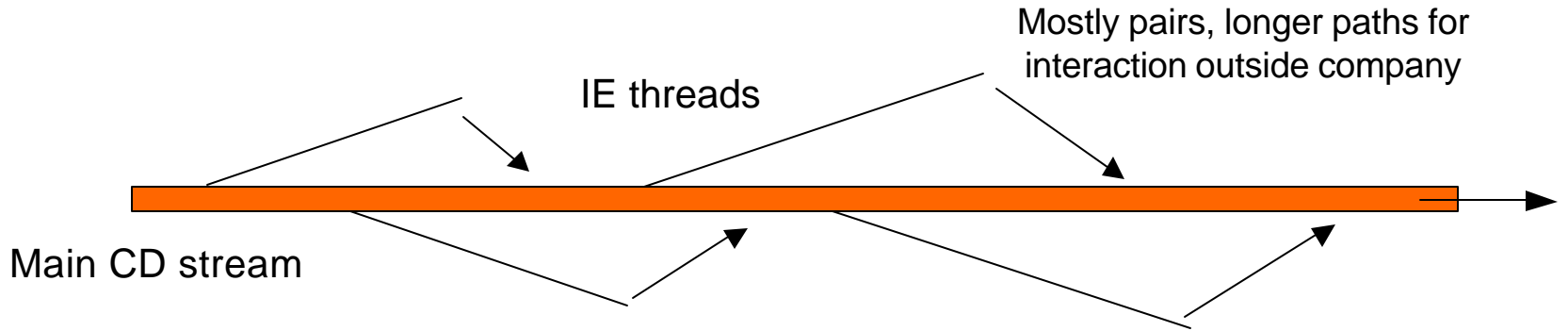
Design process – iterative development cycles of:

variables (“volumes”, “pressures”)

creating (“models”, “dimensions”)

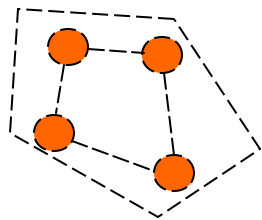
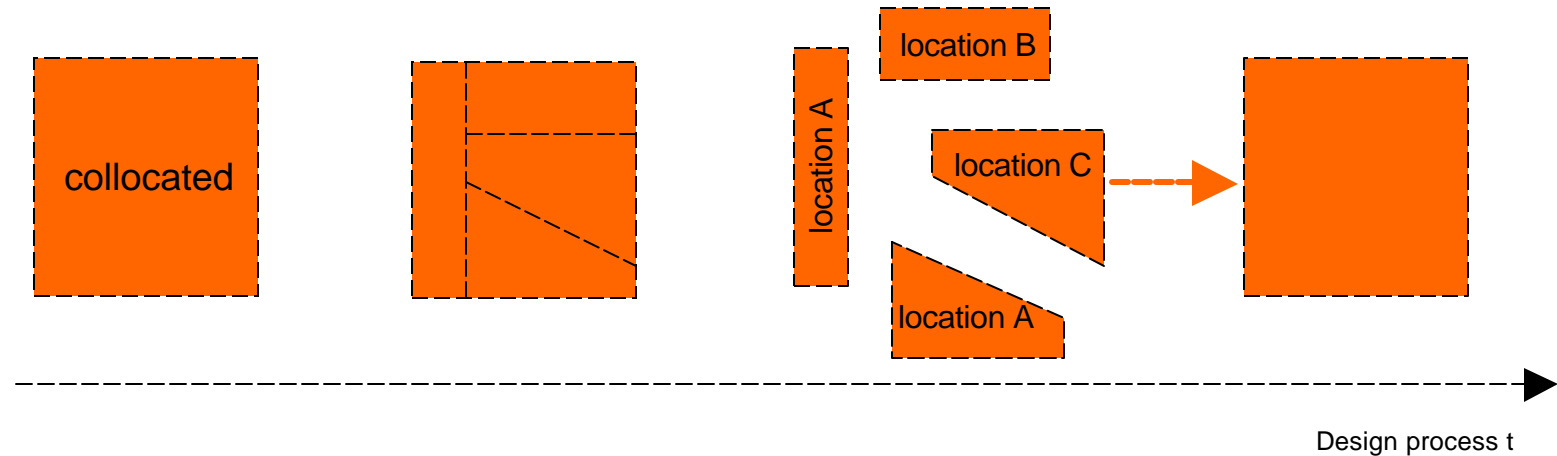
evaluating (“adapting”, “disagreeing”)

○○○ Findings



○○○ Findings

Decomposition and reconstitution



Creative design, collocated within sub-systems level;

Routine design, distributed within product level

Focus of future work = detail design level, reconciling distributed sub-systems, interfaces and distributed work within sub-systems. Resolving conflict on local and global perspectives

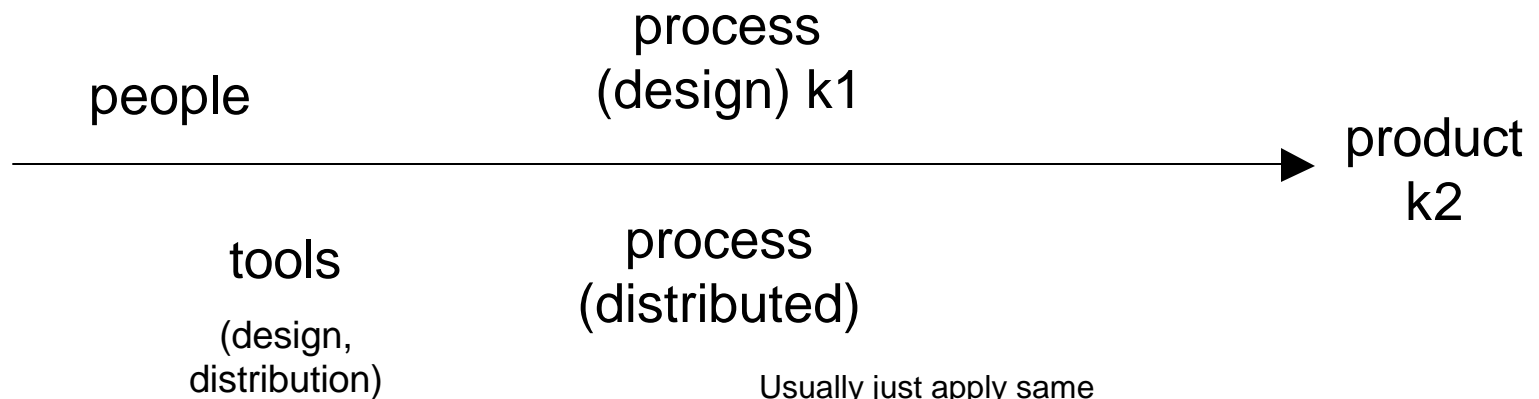
○○○ Findings

The distributed design ecosystem?

Types of relationship, temporary, permanent

Resource allocation based on traditional collocated landscapes, wrong context?

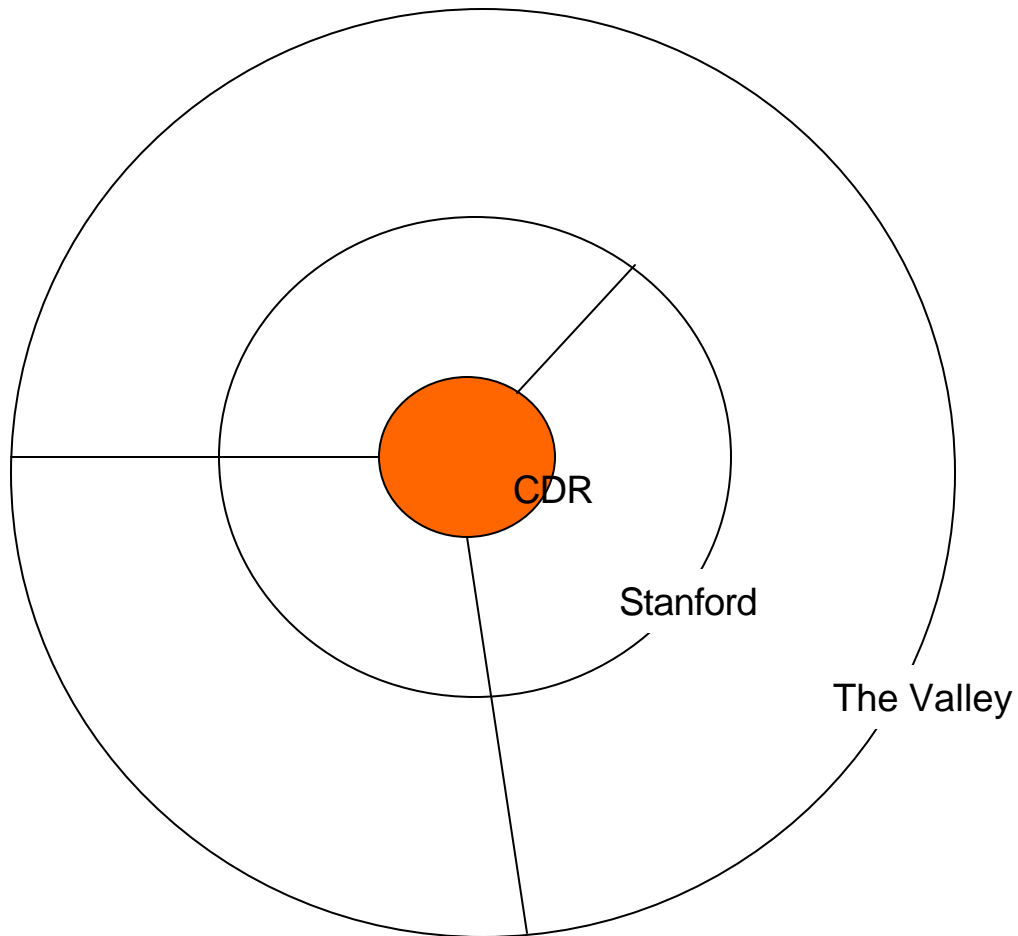
levels of distributed work, support?



Usually just apply same process based on traditional collocated landscapes

Traditional focus of research to support process – can come later in research cycle?

○○○ Stanford augmentation



○○○ Stanford augmentation

CDR level

Related research – direct and indirect, Milne and Eris

Fresh viewpoint, rigour etc

Other methodologies for a PhD project

Investigative techniques

Design observatory

Science and protocol behind laboratory experiments

Contrast with KITE studies in the field

Basis for collaboration

○○○ Stanford augmentation

CDR level

Related research – Eris and Leifer – questioning in the design process

Can we look at the questioning of a design researcher and compare to the questioning of a designer?

Actions

Temporal development of KITE case studies – questions asked – compare to experiments on artifact design?

DO experiments

Two 90 minute sessions on case study mechanics and case study content

○○○ Stanford augmentation

Stanford level

MS and E (WTO) Pamela Hinds, Diane Bailey

Increasing analysis rigour

Management expertise

Civil - Ray Levitt

Management expertise

Industrial experience

Design process within a different context

Increasing rigour, improving holistic approach

○○○ Stanford augmentation

Valley level

Networking

Industry augmentation

Success criteria and distributed problems

Microsoft, SUN, Ideo, bom.com, Cisco Systems

*Successful companies do not necessarily have successful
distributed development!*

Informs different requirements in distributed work
Boeing with a different agenda/process from Microsoft

○○○ Stanford augmentation

Success criteria of companies

IDEO

Strengths – successful integration of diverse disciplines,
integration and prototyping early in the design process

Distributed problems – distributed parts of the design team
designing within the same sub-system

Cisco

Successful integration of acquisitions

No problems with legacy data – young company

Others – ensuring quality of distributed work, hand-offs (discontinuity)

○○○ Emerging HP's

Detail design area of greatest leverage for DDT's

Front end should be collocated

Sub-system design and their integration into complete products are of particular interest in distributed design

There is conflict between the designers view point of local (sub-system) and global (complete product) design issues

There is still a gap with respect to mapping the diversity of distributed design work – the distributed design ecosystem

Shear diversity of the distributed design ecosystem renders many tools of limited use within present environments

○○○ Emerging HP's

We have to address DDT's at basic human, organisational, management level

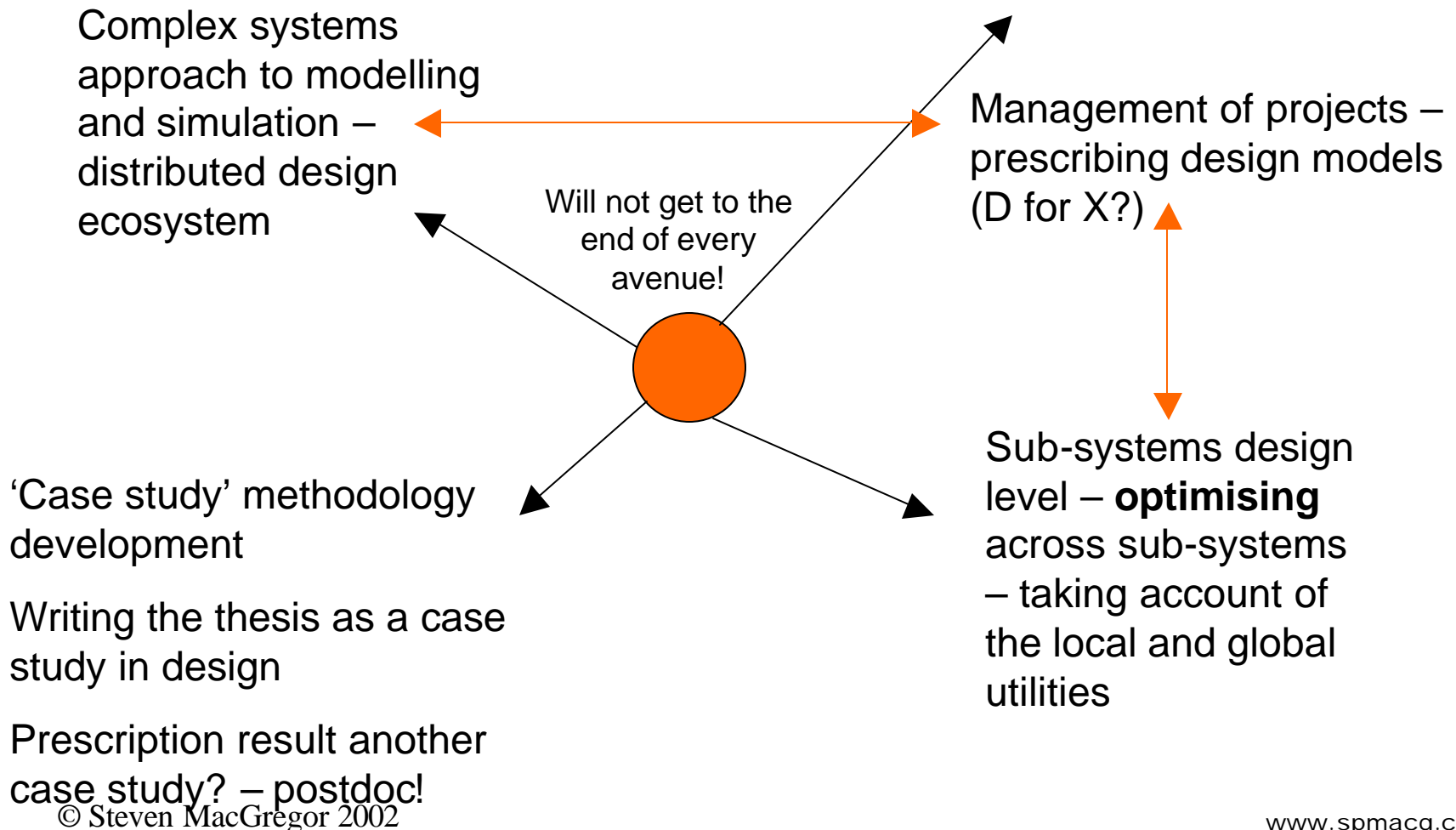
Management needed, distributed design process management, to take account of new distributed landscapes

Architecture of teams needs to be addressed – architecture/dynamics relationship

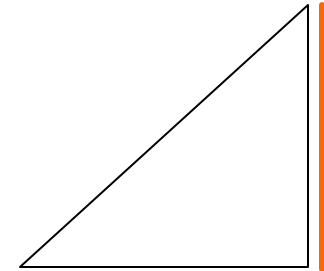
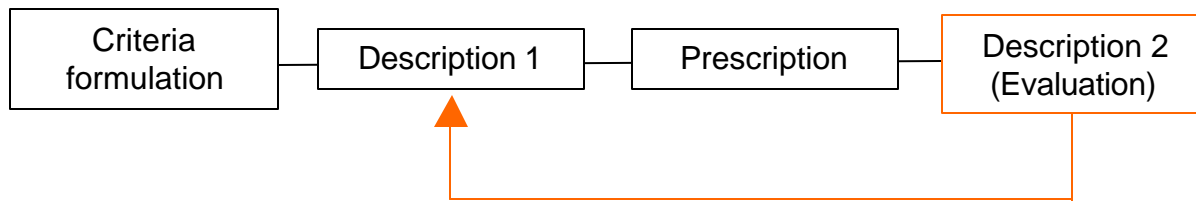
Architecture - and dynamic-centric projects

Need to gain greater insight into industry and develop data collection methods which will be of low impact and high value

○○○ Avenues of exploration



○○○ Avenues of exploration



Games (Schon, Bucciarelli)

Training (SUN)

Manager/engineer level – “everyone’s role as a student”

Sharing results with original/different case subjects – different locations

Repeat observation/data collection with renewed focus (3rd iteration)

Laboratory experiments (pre-test, post-test)

○○○ Summary/conclusions

Methodology on several levels tightened

Stanford environment not only adding to data set but complimenting it – trace line of logic, development

Foundations laid as opposed to work completed

New directions, future collaborations

Focus? Contribution? How to close loop?

○○○ Future work

Reflect/formalise, establish stronger chain of evidence

Finishing manual analysis, then software coding

Computer science augmentation - Calgary

Prescription investigation – avenues of exploration

Industrial success criteria – Lever, ABB – project info., filling the gaps
– more travelling!

Collaboration - personal and department level

By the way, enjoy Glasgow!