

Science, Design & Design Science

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Background

- McKay & Marshall (2005) criticised the conceptualisation of Design Science by IS academics in the US
 - Agreement on relevance of ‘design’ to IS
 - Disagreement on how design is best conceptualised in IS
- This paper attempts to consider how we can think about design & design science if these notions are to be useful to progressing our understanding & practice in IS

Introduction

- Need in IS to recognise social & technical aspects of systems, & the fact that they are historically & contextually situated
 - ‘design’ is a ‘natural’ way of thinking about what we do in IS
 - BUT are we talking about designing a technical artifact, or a social artifact, or...?
 - ‘design’ needs to be thought of as occurring in context, with social, cultural, political dimensions, etc

Introduction

- Need clarity around what we mean by
 - Design
 - Science
 - Design science
 - Design science as a paradigm
 - Design science research
 - Design science as a research method

What is 'Science'?

- *“intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment”*

(New Oxford American Dictionary 2007),

“branch of knowledge conducted on objective principles involving the systematised observation of and experiment with phenomena, esp. concerned with the material and functions of the physical universe”

(New Zealand Oxford Dictionary 2007).

What is 'Science'? – S_1 or S_2 ?

- S_1 – defined or characterized by the methods, formalisms, approaches to building knowledge rather than the content matter of that knowledge
- Scientists study any phenomena: what distinguishes it as science is the use of intellectual procedures such as observation, experimentation, measurement, theorizing and testing, not the object(s) of study

What is 'Science'?

- S_2 – a coherent body of knowledge built in a systematic and disciplined way
- S_2 perspective -- research may be deemed to be scientific if it is deemed to be systematic and rigorous in its conduct and its claims to knowledge generation

Part of the Problem -- 1

- Many US researchers conceptualise DS from S_1 perspective
- Europe and Australia tending to take S_2 perspective

Distinguishing the Sciences

		Positivist	Interpretivist	Critical
Natural Science	S ₁			
Behavioural Science	S ₁			
	S ₂			
Social Science	S ₁			
	S ₂			

What is a Paradigm?

- March & Smith (1995) – natural science and design science are ‘species’ of science
- Hevner et al. (2004) citing March & Smith (1995) – behavioural science paradigm and design science paradigm
- So what is a paradigm?
 - Is design science a paradigm?

What is a Paradigm?

- Associated with
 - Theoretical perspective -- Worldview
 - Research tradition or orientation
 - Ontological & epistemological assumptions
- ***ontological, epistemological, and methodological set of assumptions which guide and direct investigation or research and the establishment and evaluation of knowledge***
- conceptual and philosophical framework incorporating the methods and tools by which researchers conduct investigations into areas of interest, the problems of interest, and the means by which research is evaluated

S_1 , S_2 and Paradigms

- S_1 – conflation of body of knowledge (*content*) + conceptual & philosophical framework which guides method by which knowledge is acquired (*paradigm*)
- S_2 – multi-paradigmatic (more than one stance helpful in building knowledge in discipline)

Paradigm \neq body of knowledge

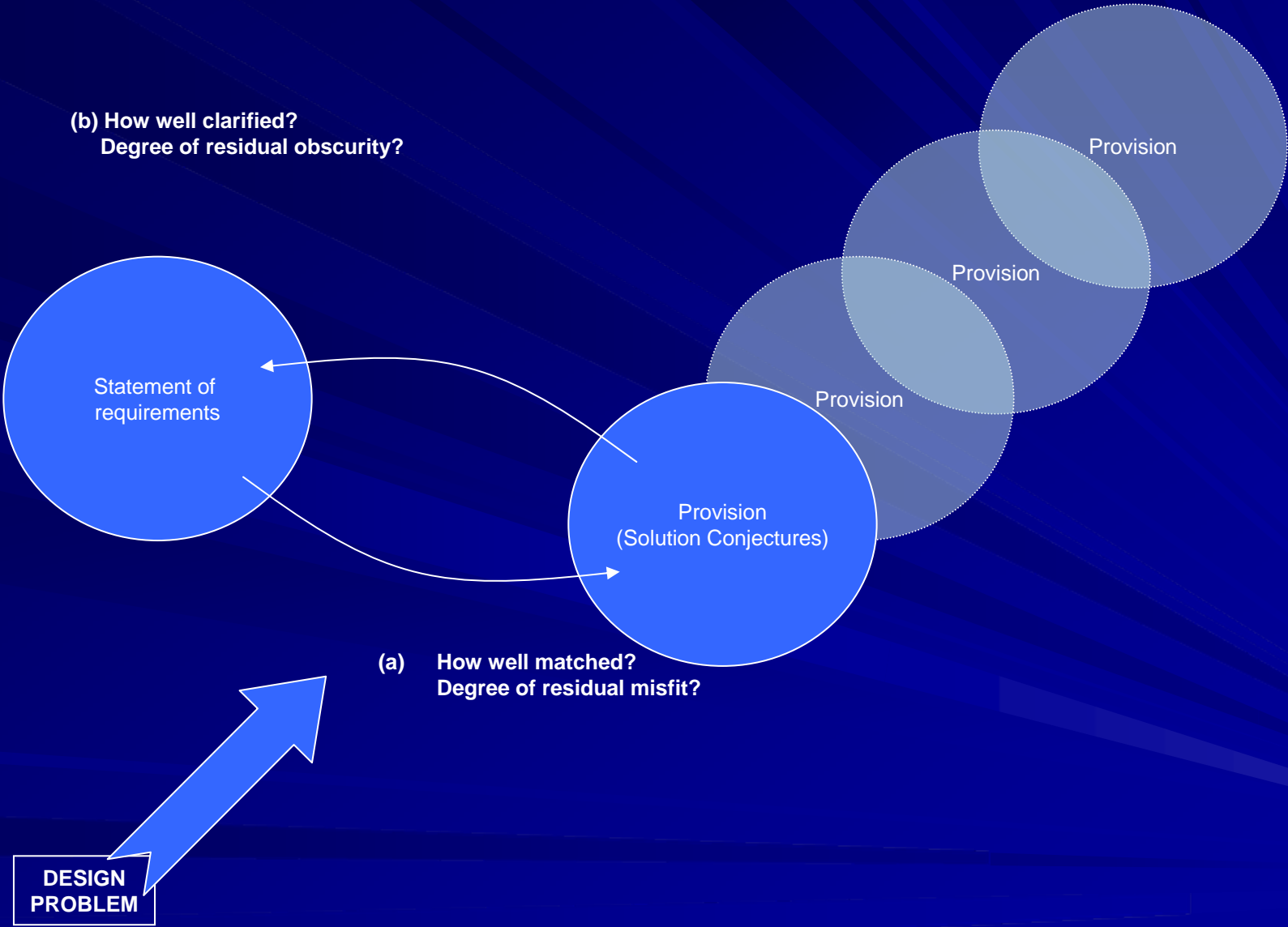
What is Design?

- *To some, it is an art, to others, it is a science, and to others it is a reflective practice.*
 - Product view of design (object)
 - Process view of design (activity)
 - Professional practice (designer in context)

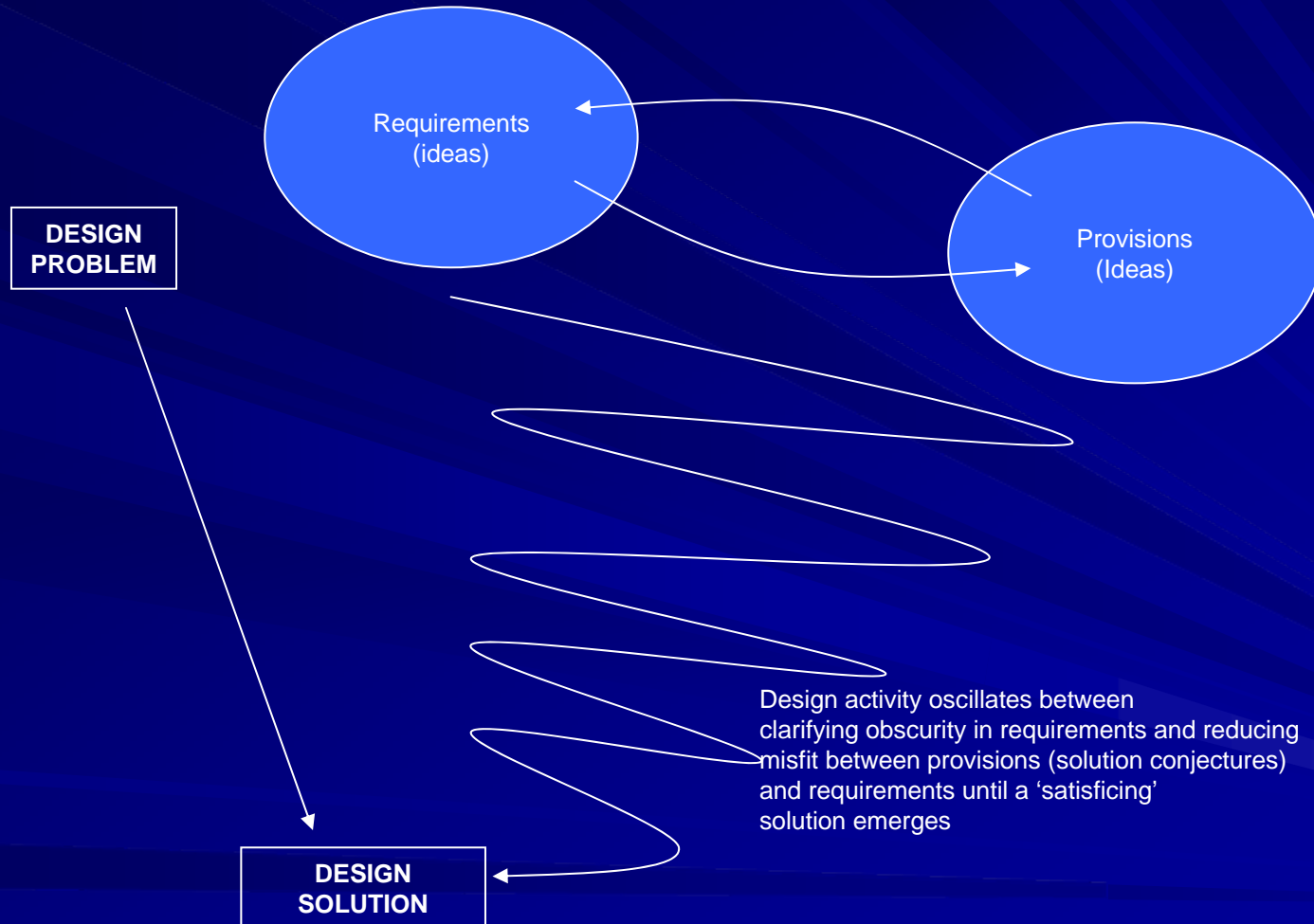
Part of the Problem -- 2

- Many US researchers conceptualise DS from a product perspective
- Europe and Australia tending to take a product + process + professional practice (PPP) perspective
- Trend in other disciplines (Engineering, Management, Design, Industrial Design, Management Science, etc) has been to move from product to PPP

What is a design problem?



What is design activity?



What is Design Science?

- *“a federation of sub-disciplines having design as the subject of their cognitive interests”.*

SCIENCE

Knowledge gained through application of the scientific method

HUMANITIES

Knowledge gained about being human, human values, and the expression of the spirit of mankind

DESIGN

Knowledge of the material culture, nature of artefacts and the skills and experience required for their production and use

(from Archer 1979)

What is Design Science?

- DS is defined as the science of the material culture (Archer 1979b) or artificial world (Cross 2001), the study of the skills, experience, expertise, values, technologies and knowledge involved in design.

DS₁ and DS₂

- In line with S₁ and S₂ we can talk of DS₁ and DS₂
- DS₁ – technical scientific conception of Design Science
- DS₂ – more holistic and sociotechnical view of design in which organisational context is important

What is Design Science?

- Cross (2001:52-53) argues that the **DS₁ perspective** has been concerned with the articulation of a “*design method*”, a rationalized version, with possible slight variances, of the scientific method for the context of design
- from this **S₁ perspective** “*design science refers to an explicitly organized, rational, and wholly systematic approach to design; not just the utilization of scientific knowledge of artifacts, but design in some sense as a scientific activity itself.*”

What is Design Science?

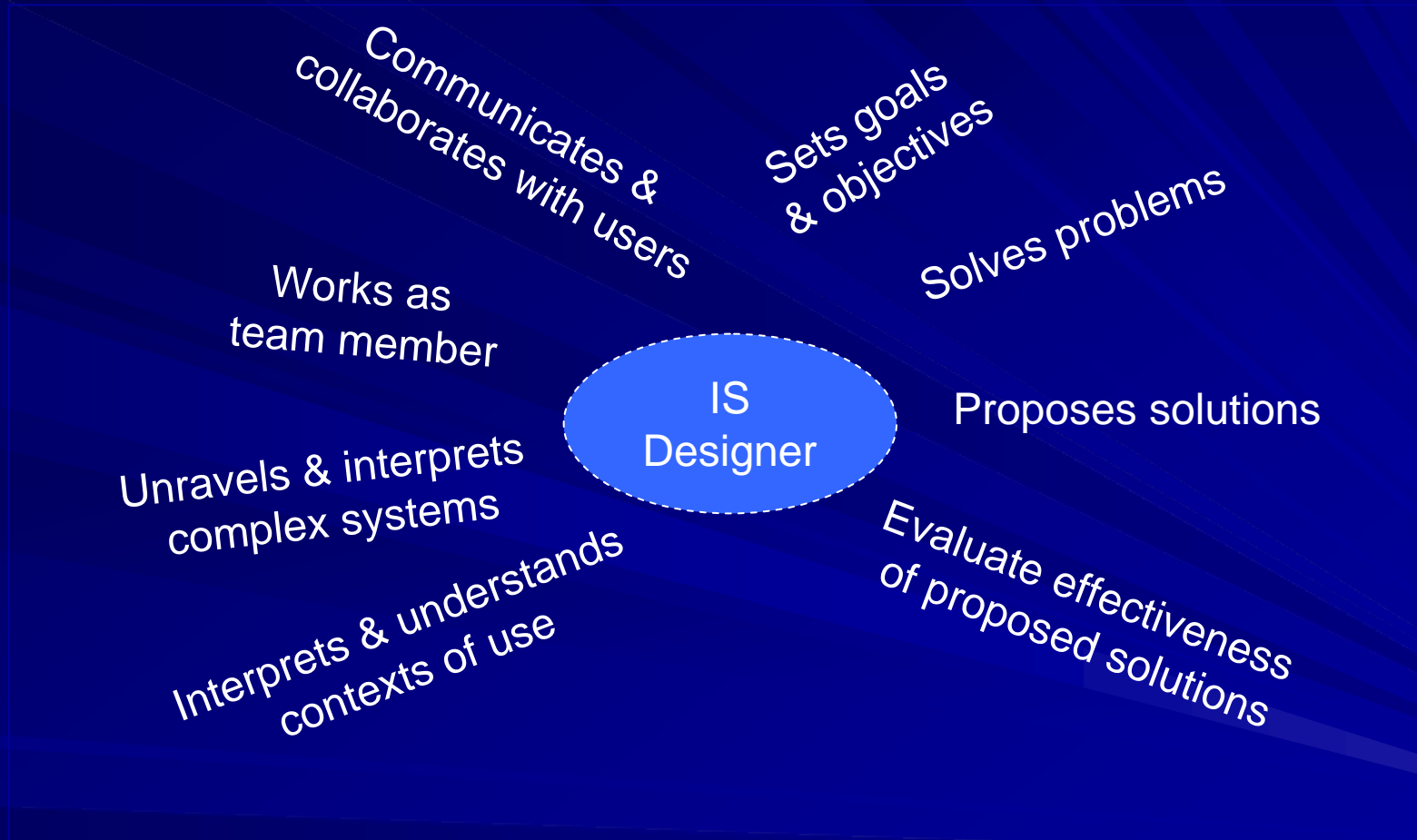
- However, Cross (2007) bemoans such attempts to ‘scientise’ design, supporting Grant’s (1979) view that *“the act of designing itself is not and will not ever be a scientific activity”*.
- Cross (2001:53) goes on to discuss DS₂, suggesting that the science of design

“refers to that body of work which attempts to improve our understanding of design through “scientific” (i.e. systematic, reliable) methods of investigation...the study of the principles, practices, and procedures of design...includes the study of how designers work and think, the establishment of appropriate structures for the design process, the development and application of new design methods, techniques and procedures, and reflection on the nature and extent of design knowledge and its application to design problems”.

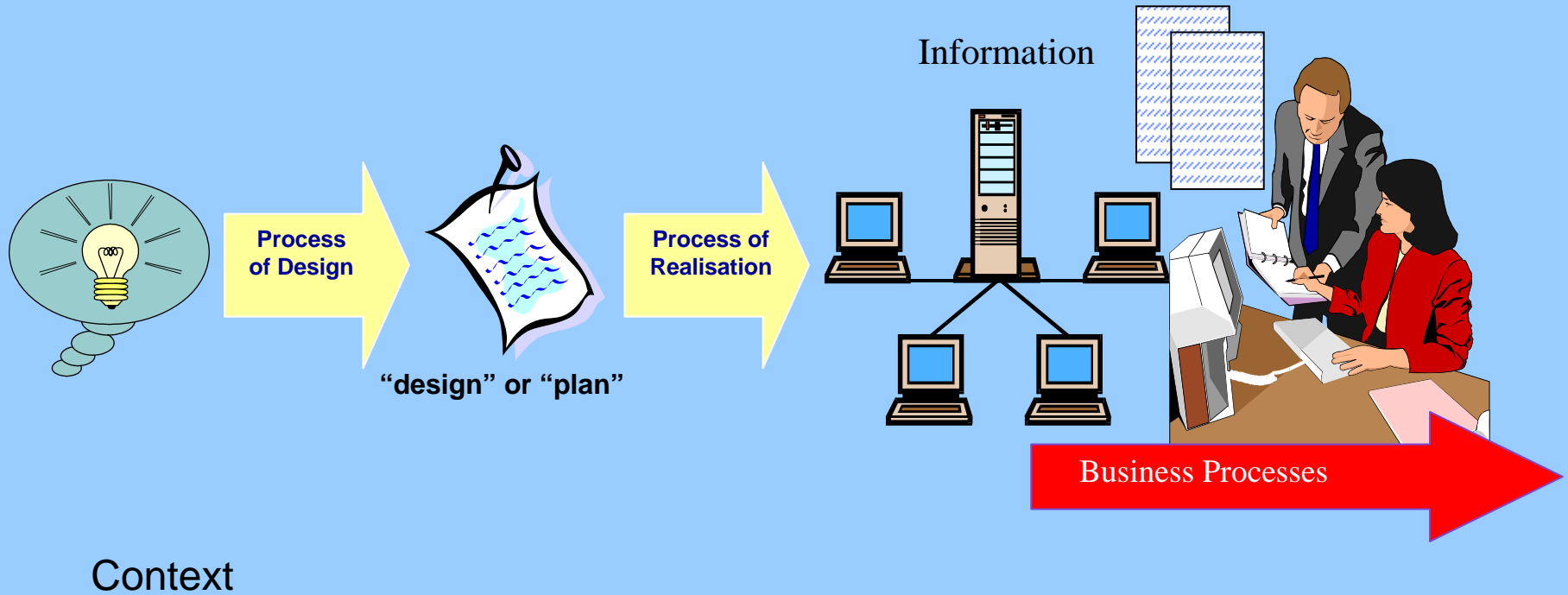
Positive Future Role for DS in IS

- Sociotechnical nature of design in IS
- Broaden from technical view of design (product) or scientific process to sociotechnical perspective (PPP)
- Importance of relationships between designers, designed artefacts, contexts in which these artefacts are deployed & used

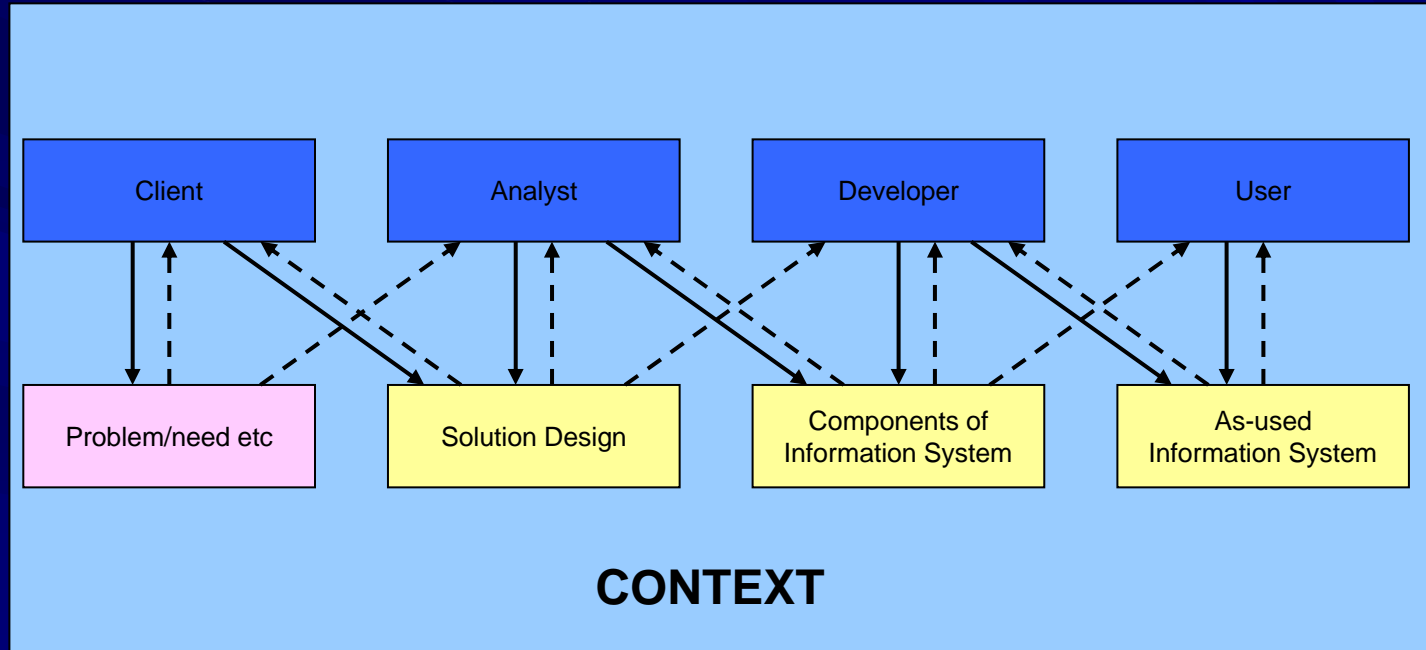
DS in IS: Many Roles of the Designer



DS in IS



DS in IS



DS in IS

- Agree with Mumford (1995) that technical design is only one part of a large, complex design process which includes everything that both interacts with the technical system and surrounds it in the total design task
- We view the focus on the technical artifact, stripping away context as unhelpful in advancing the IS discipline, & particularly worrying when this becomes construed as DS research
- Boland (2004) & Boland & Lyytinen (2004) argue for firmly positioning design activity in IS in a socio-technical context – further arguing that misguided attempts to split out the technical artifact fundamentally and negatively impacts & alters the sociotechnical system

DS Research in IS

- Exclusivity (DS_1) or inclusivity (DS_2)?
- In fields with more maturity in DS such as Engineering, Management, MS/OR & Industrial Science, DS has moved from a narrow positivist conceptions to more diverse, inclusive & multi-paradigmatic perspectives
- DS_2 because
 - Designer inextricable part of design
 - Recognises ‘value-full’ aspects of design
 - Allows for understanding of designers, designs, contexts of use

DS in IS - at the crossroads?

- Fundamental question regarding DS in IS:
 - Do we continue with the predominance of the DS₁ perspective, investigating primarily the technical artifact, or do we, while recognising the technological focus of our discipline, embrace the more inclusive DS₂ traditions?

DS in IS - at the crossroads?

- In IS we need to cultivate a DS₂ perspective since it is important to understand:
 - The oscillation (practice) of design activity
 - The interactions between the various roles and actors involved
 - The interactions between the various artifacts involved in the design and design-realisation process, and between actors & artifacts in these processes
 - The attributes, skills and knowledge required of the actors involved
 - The impacts that design artifacts have on their contexts of use