

The Influence of Situational Factors in Software Product Management: An Empirical Study



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Overview



- **Introduction**
 - Research trigger
 - Research aim
 - Research question
 - Previous work
 - Case study company
- **Results**
 - List situational factors
 - Influence study
 - Constraints study
- **Summary / Conclusion**
- **Questions / suggestions**

Research Trigger



- Product managers play a crucial role in the success of product software companies (Condon, 2002)
- Best known SPI methods:
 - CMM (Paulk, Curtis, Chrissis, & Weber, 1993)
 - CMMI (CMMI Product Team, 2002)
 - SPICE (ISO/IEC-15504, 1998)
- Why not?
 - Found too heavy to use by organizations (Cusamo, 2004)
 - Too large to implement, or even comprehend (Kuilboer & Ashrafi, 2000) (Reifer, 2000)
 - Too expensive for many small and medium sized companies (Brodman & Johnson, 1994)

Aim research



To expand the research in the field of software product management (SPM), by finding out which situational factors influence the selection process of method fragments. Thus allowing software process improvement to be enhanced by tuning the selection of method fragments to the companies environment.

Research question

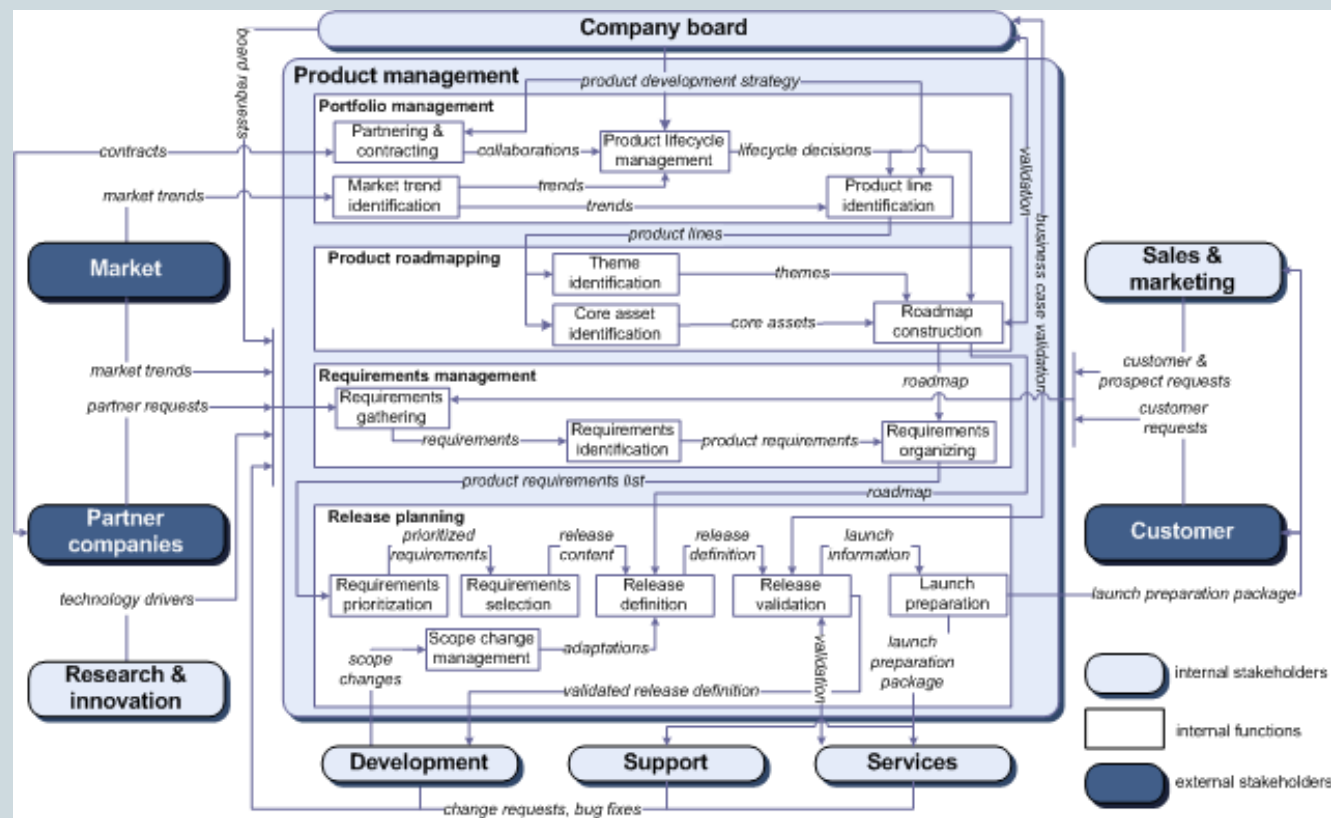


“What are the most important situational factors influencing the selection of method fragments for software product management processes?”

Previous work



- Framework for software product management (Weerd I. v., Brinkkemper, Nieuwenhuis, Versendaal, & Bijlsma, 2006)



The case company



- IT company which manages the IT needs of numerous customers on a daily basis
- Implement large-scale projects in a wide variety of markets including local government, financial services, housing associations and wholesale
- Offices in The Netherlands, Belgium, Germany and Norway, and more...
- Various areas of expertise; consultancy, *IT solutions*, *software engineering*, e-business, systems integration, managed ICT services and training.
- More than 50 takeovers since the year 2000

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List of situational factors



- Developed based on:
 - Literature research
 - Interviews with experts from practice
 - Interviews with experts from scientific community
- 31 situational factors
- Five categories
- Named, described, specified unit

Situational factor	Description	Unit
Business philosophy	An indicator showing the company's business philosophy the business unit follows. E.g. SCRM, which is open.	Open / Closed
Size of business unit	An indicator of the total number of employees working at the business unit, expressed in FTE (full-time equivalent). An FTE of 2.0 means that the person is expected to full-time work, while an FTE of 0.5 signals that the worker is only half-time.	Accumulated FTE of all business unit employees
Size of development team	An indicator of the total number of developers, expressed in an accumulation of all the developers' FTEs.	Accumulated FTE of all developers
Customer loyalty	Indicates the loyalty of the customer by judging the likelihood that the customer will switch to another software supplier.	Low / Medium / High
Customer satisfaction	Indicates the level of customer satisfaction, measured on a scale of 1 to 10, where 1 is the lowest and 10 is the highest level of satisfaction.	Scale of 1 to 10
Customer stability	An indicator showing how many percent of the customers have customer-specific features or adaptations of features implemented.	Percentage of customers that have customer-specific features
Number of customers	An indicator of the number of customers that use the product.	Number of customers
Number of end-users	An indicator showing the number of end users the product has.	Number of end-users
Type of customers	This indicator shows the type of customers the product is mainly intended for; they can be individuals, small companies, medium companies, or large companies.	Individuals / Small companies / Medium companies / Large companies / All
Hosting services	Indicates what type of services there are upon the type of hosting service the user demands. You can have co-located hosting or hosting at the customer site.	Co-located hosting service / Customer server
Localization demand	This indicator shows the amount of localizations are present in the product.	Number of localizations
Market growth	This indicator shows the direction in which the market (number of potential customers for the product) is growing. It can be growing, stable, or decreasing.	Growing / Stable / Decreasing
Market size	This indicator shows how large the market (potential number of customers) is.	< 1000 Customers / 1000-10000 Customers / > 10000 Customers
Release frequency	The release frequency (in days), this can sometimes be required upon the company. When a release has a code containing functional changes, and not only bug fixes.	Number of days
Sector	In which sector does the business unit operate, e.g. public, non-profit, government, etc.	Free to fill out the sector
Standard compliance	The market conditions show a strong demand for certain standards, this situational factor indicates the level of that demand.	Low / Medium / High
Stability of future requests	This indicator shows the stability of the demands made on the product by the market. The higher it is, the lower the variability in the future requests.	Low / Medium / High
Support age	Indicates the age of the product by looking at number of months passed since the first release of the product until the current point in time.	Number of months
Defects per year (total)	The total number of defects per year reported by external parties.	Defects per year
Defects per year (serious)	The total number of serious defects per year, so called 'show stoppers', reported by external parties.	Serious defects per year
Development performance	An indicator showing how mature the technology that is being used on the product, it can be new, well changing, or fully developed.	New / Well changing / Fully developed
New requirements	Number of new feature requests per year from customers and users.	Feature requests per year
Number of products	This indicator tells how many other products there are in the product line for the product (this can thus be zero to many).	Number of products
Product lifetime	An indicator showing how long the product will remain in production starting from the current point in time. This indicator thus shows the products remaining lifetime, how long the product already exists from the beginning of the calculation.	Number of years
Product size	An indicator of the number of lines of code (excluding comments) of which the product exists (measured in KLOC (thousand lines of code)).	KLOC
Product maturity	Some products are more mature than others, if we take for example an application which is under development, it is not stable for any defects or all issues it will not be great immediate if not implemented designed to a business, where a back office application which is not only once per week and is not essential can be non-functioning for a short while without serious consequences.	Low / Medium / High
Software Platform	The software framework the business unit uses, e.g. .NET	Free to fill out software framework
Company policy	The level of influence the company policy has on the business unit and processes. This indicator shows to what extent the business unit respects rules upon the business unit, such as technology, and functional demands.	Low / Medium / High
Customer involvement	The level of customer involvement in the decision which standard features will be implemented, and how these will be implemented.	Low / Medium / High
Legislation	This indicator shows the level of influence of legislation imposed upon the software product by government bodies, which can be strict or loose to non-existing.	Strict / Loose / Non-existing
Partner involvement	The level of influence partner enterprises have with regard to the business unit decisions such as development, and implementation decisions.	Low / Medium / High

List of situational factors examples



- Customer characteristics
 - Number of customers
 - Type of customers

Situational factor	Description	Scale
Business philosophy	An indicator showing the company's business philosophy. The business unit follows, e.g. SCRM, which is open.	High / Medium / Low
Size of business unit	An indicator of the total number of employees working at the business unit, expressed in FTE (full-time equivalent). An FTE of 2.0 means that the person is expected to full-time work, while an FTE of 0.5 equals that the worker is only half-time.	Accumulated FTE of all business unit employees
Size of development team	An indicator of the total number of developers, expressed in an accumulation of all the developers' FTEs.	Accumulated FTE of all developers
Customer loyalty	Indicates the loyalty of the customer by judging the likelihood that the customer will switch to another software supplier.	Low / Medium / High
Customer satisfaction	Indicates the level of customer satisfaction, measured on a scale of 1 to 10, where 1 is the lowest and 10 is the highest level of satisfaction.	Scale of 1 to 10
Customer stability	An indicator showing how many percent of the customers have customer-specific features or adaptations of features implemented.	Percentage of customers that have customer features
Number of customers	An indicator of the number of customers that use the product.	Number of customers
Number of end users	An indicator showing the number of end users the product has.	Number of end users
Type of customers	This indicator shows the type of customers the product is mainly intended for; they can be individuals, small companies, medium companies, or large companies.	Individuals / Small companies / Medium companies / Large companies / All
Hosting domain	Indicates what type of domains there are upon the type of hosting service the market demands. You can have central hosting or hosting at the customer site.	Central hosting service / Customer server
Localization demand	This indicator shows the amount of localizations are present in the product.	Number of localizations
Market growth	This indicator shows the direction in which the market (number of potential customers for the product) is growing. It can be growing, stable, or decreasing.	Growing / Stable / Decreasing
Market size	This indicator shows how large the market (potential number of customers) is.	<1000 customers / 1000-10000 customers / >10000-100000 customers / >100000 customers
Release frequency	The release frequency (in days), this can sometimes be required upon the company where it releases its software containing functional changes, and not only bug fixes.	Number of days
Sector	In which sector does the business unit operate, e.g. public, non-profit, government, etc.	Free to fill out the sector
Standard compliance	The market sometimes shows a strong demand for certain standards; this situational factor indicates the level of that demand.	Low / Medium / High
Variability of future requests	This indicator shows the stability of the demands made on the product by the market. It is judged at the level of variability in the future requests.	Low / Medium / High
Support age	Indicates the age of the product by looking at number of months passed since the first release of the product until the current point in time.	Number of months
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Product lifetime	An indicator showing how long the product will remain in production starting from the current point in time. This indicator thus shows the products remaining lifetime, how long the product already exists from the beginning of the calculation.	Number of years
Product size	An indicator of the number of lines of code (excluding comments) of which the product exists (measured in KLOC (thousand lines of code)).	KLOC
Product intensity	Some products are more sensitive to bugs than others; if we take for example an application which tracks bank transactions then it cannot allow for any defects at all since it could cause great inconvenience for the customer. In a business, where a back office application which is not only once per week used is more essential can be non-functioning for a short while without serious consequences.	Low / Medium / High
Software Platform	The software framework the business unit uses, e.g. .NET	Free to fill out software framework
Company policy	The level of influence the company policy has on the business unit development process. This indicator shows to what extent the business unit respects rules upon the business unit, such as technology, and functional demands.	Low / Medium / High
Customer involvement	The level of customer involvement in the decision which customer features will be implemented, and how these will be implemented.	Low / Medium / High
Legislation	This indicator shows the level of influence of legislation imposed upon the software product by government bodies, which can be strict or more lenient.	Strict / Loose / Non-existing
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List of situational factors examples



- Market characteristics
 - Market size
 - Release frequency

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Number of end-users	An indicator showing the number of end users the product has.	Number of end-users
Type of customers	This indicator shows the type of customers the product is mainly intended for; they can be individuals, small companies, medium companies, or large companies.	Individuals / Small companies / Medium companies / Large companies / All
Hosting demands	Indicates what type of demands there are upon the type of hosting service the market demands. This can cover licensing or hosting at the customer site.	Central hosting service / Customer server
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Development platform maturity	An indicator showing how mature the technology that is being used on the product, is, can be new, ever changing, or fully developed.	New / Ever changing / Fully developed
New requirements	Number of new feature requests per year from customers and users.	Feature requests per year
Number of products	This indicator tells how many other products there are in the product line for the product (this can thus be zero to many).	Number of products
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Product size	An indicator of the number of lines of code (excluding comments) of which the product exists (measured in KLOC (thousand lines of code)).	KLOC
Product stability	Some products are more sensitive to bugs than others. If we take for example an application which tracks bank transactions then it cannot allow for any defects at all since it could cause great economical and/or medical damage to the business, where a back office application which is not only once per week used is more resistant to be non-functioning for a short while without serious consequences.	Low / Medium / High
Software platform	The software framework the business unit uses, e.g. .NET	Free to fit out software framework
Company policy	The level of influence the company policy has on the business unit development process. This indicator shows to what extent the business unit respects rules upon the business unit, such as technology, and functional demands.	Low / Medium / High
Customer involvement	The level of customer involvement in the decision which product features will be implemented, and how these will be implemented.	Low / Medium / High
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List of situational factors examples



- Product characteristics
- Product age
- Product lifetime

Situational factor	Description	Scale
Business philosophy	An indicator showing which concept of management philosophy the business unit follows. E.g. SCRM, which is open.	High / Medium / Low
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Number of customers	An indicator of the number of customers that use the product.	Number of customers
Number of end-users	An indicator showing the number of end users the product has.	Number of end-users
Type of customers	This indicator shows the type of customers the product is mainly intended for; they can be individuals, small companies, medium companies, or large companies.	Individuals / Small companies / Medium companies / Large companies / All
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Market size	This indicator shows how large the market (potential number of customers) is.	<1000 Customers / 1000-10000 Customers / 10000-100000 Customers / >100000 Customers
Release frequency	The release frequency (in days), this can sometimes be negative upon the company where it releases the software containing functional changes, and not only bug fixes.	Number of days
Sector	In which sector does the business unit operate, e.g. public, non-profit, government, etc.	Free to fill out the sector
Standard dominance	The market sometimes shows a strong demand for certain standards, this situational factor indicates the level of that demand.	Low / Medium / High
Variability of feature requests	This indicator shows the stability of the demands made on the product by the market. It is judged at the level of variability in the feature requests.	Low / Medium / High
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Product size	An indicator of the number of lines of code (excluding comments) of which the product exists (measured in KLOC (thousand lines of code)).	KLOC
Product intensity	Some products are more sensitive to bugs than others. If we take for example an application which tracks bank transactions then it cannot allow for any defects at all since it could cost great monetary value upon the bank's customers. Whereas in a back office application which is not only once per week and is non-critical can be non-functioning for a short while without serious consequences.	Low / Medium / High
Software Platform	The software framework the business unit uses, e.g. .NET	Free to fill out software framework
Company policy	The level of influence the company policy has on the business unit development process. This indicator shows to what extent the business unit respects rules upon the business unit, such as technology, and functional demands.	Low / Medium / High
Customer involvement	The level of customer involvement in the decision which product features will be implemented, and how those will be implemented.	Low / Medium / High
Legislation	This indicator shows the level of influence of legislation imposed upon the software product by government bodies, which can be strict or more lenient.	Strict / Loose / Non-existing
Partner involvement	The level of influence partner enterprises have with regard to the business unit decisions such as development, and implementation decisions.	Low / Medium / High

Influence study



- All 14 interviewees are experienced product managers
- Influence indicated on 7 points Likert scale for the domains of the framework for SPM
 - Portfolio management
 - Product roadmapping
 - Release planning
 - Requirements management
- All experts used the same SF definitions
 - Varying opinions cause deviations in influence
- Removed unreliable results
- Strongly correlated SFs are aggregated

Results: Business unit char. influence



- Main influence on release planning & requirements management, limited overall importance
- Size business unit team & Size development team merged

	Portfolio management		Product roadmapping		Release planning		Requirements management	
	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ
Business unit characteristics	1,82		2,10		3,14		2,77	
Development philosophy	1,45	1,036	1,64	1,433	2,55	1,572	2,27	1,272
Size of business unit team	2,18	1,401	2,55	1,572	3,73	2,149	3,27	2,240
Size of development team	2,36	1,748	2,82	1,940	3,73	2,370	3,13	2,562

	Portfolio management		Product roadmapping		Release planning		Requirements management	
	r	p	r	p	r	p	r	p
Pair of situational factors								
Size business unit team & Size development team	0,914	0,000	0,957	0,000	0,779	0,003	0,935	0,000

Results: Customer char. influence



- Most important group
- Number of customers & number of end-users merged

	Portfolio management		Product roadmapping		Release planning		Requirements management	
	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ
Customer characteristics	3,54		3,60		2,82		3,25	
Customer loyalty	4,09	1,973	3,91	1,700	2,64	1,690	2,82	1,888
Customer satisfaction	3,91	1,921	4,00	1,949	3,27	1,191	3,73	1,489
Customer variability	3,18	2,040	3,45	2,115	3,55	2,252	3,82	2,089
Number of customers	3,27	1,794	3,09	1,578	2,18	1,888	2,45	1,864
Number of end-users	2,36	2,157	2,18	1,888	1,64	1,502	1,73	1,555
Type of customers	3,27	1,794	3,55	1,695	2,45	1,508	3,45	2,018

	Portfolio management		Product roadmapping		Release planning		Requirements management	
	r	p	r	p	r	p	r	p
Pair of situational factors								
Number of customers & Number of end-users	0,850	0,000	0,804	0,002	0,845	0,001	0,866	0,000

Results: Market char. influence



- Overall, relative little importance
- Some star SFs:
 - Sector, Variability among feature requests
- Release frequency factor removed

	Portfolio management		Product roadmapping		Release planning		Requirements management	
	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ
Market characteristics	2,44		2,73		2,36		2,19	
Hosting demands	1,55	0,934	1,82	1,168	1,82	1,401	1,64	0,924
Localization demand	2,00	1,789	2,91	2,071	2,91	2,548	2,27	1,618
Market growth	3,36	2,111	3,09	2,166	1,82	1,079	1,45	0,688
Market size	3,18	2,228	2,55	1,968	1,27	0,647	1,27	0,647
Release frequency	1,64	1,804	2,27	2,370	3,36	2,461	2,82	2,228
Sector	3,09	2,023	3,36	2,335	3,27	2,328	3,64	2,580
Standard dominance	1,73	1,618	2,27	2,005	2,09	1,921	2,09	1,700
Variability of feature requests	2,18	1,779	3,09	1,973	3,36	2,838	3,00	2,280

Results: Product char. influence



- Important
- Defects per year: total & serious merged

	Portfolio management		Product roadmapping		Release planning		Requirements management	
	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ
Product characteristics	2,77		2,82		2,87		2,82	
Application age	4,20	2,201	3,90	2,234	3,50	2,369	3,40	2,366
Defects per year: total	1,73	1,191	1,36	0,924	3,00	2,236	2,73	2,149
Defects per year: serious	2,00	1,342	1,64	1,206	3,27	2,328	2,91	2,166
Development platform maturity	2,64	2,203	3,36	1,912	3,45	2,018	3,55	1,968
New requirements rate	2,91	2,212	3,00	2,236	3,18	2,316	3,55	2,252
Number of products	2,73	2,149	2,55	1,809	2,27	1,555	1,73	1,272
Product lifetime	4,55	1,753	4,36	1,804	3,45	2,382	3,36	2,378
Product size	2,73	2,005	2,91	1,814	2,55	1,753	2,82	1,991
Product tolerance	1,45	0,820	2,18	1,940	2,91	2,256	2,73	2,328
Software Platform	2,00	1,844	1,73	1,348	1,55	0,820	1,55	0,820

Pair of situational factors	Portfolio management		Product roadmapping		Release planning		Requirements management	
	r	p	r	p	r	p	r	p
Defects per year: serious & Defects per year: total	0,881	0,000	0,850	0,000	0,962	0,000	0,963	0,000

Results: Stakeholder involvement influence



- Most important group after ‘Customer characteristics’
- Number of customers & number of end-users merged

	Portfolio management		Product roadmapping		Release planning		Requirements management	
	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ	\bar{x}	σ
Stakeholder involvement	3,09		3,09		2,89		2,87	
Company policy	3,45	2,339	3,18	1,834	2,55	1,864	2,55	1,864
Customer involvement	3,36	1,748	3,64	1,912	3,18	1,888	3,91	1,868
Legislation	2,36	1,912	2,45	1,916	3,55	1,809	2,82	1,601
Partner involvement	3,18	1,888	3,09	1,814	2,27	1,555	2,18	1,662

SF based method constraints



- Based on same list of SFs as influence study
- Evaluated 26 different SPM method fragments
- SFs used most as constraint:
 - Customer involvement (46% of methods researched)
 - Development philosophy (35% of methods researched)
 - New requirements rate (27% of methods researched)
 - Release frequency (27% of methods researched)

Conclusion



- SFs influence method fragment choice
- SFs are useful as an indication of the restrictive environmental properties of method fragments
- Restrictive SFs differ from influential SFs
- SFs can be instrumental in:
 - SPM process maintenance – Does the SPM method need to be changed due to a change in environment?
 - Fragment choice – What method fragments can be applied given the business units SF values?

Future research



- More focus on higher levels of framework for SPM
- Validation of reference framework for SPM
- More case studies
- More detailed influences
- **PSKI**
 - A tool which takes a companies current SPM processes and incrementally improves them by looking at the SFs

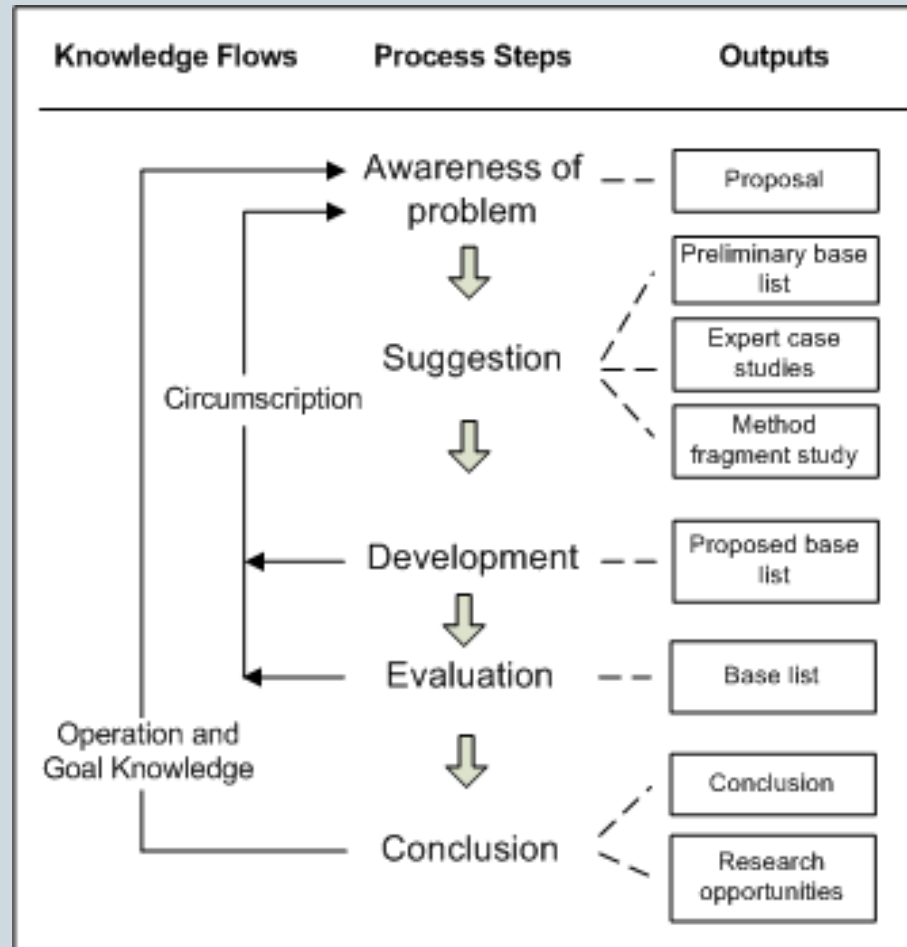
Questions



- Questions
- Suggestions

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Research approach



(Vaishnavi & Kuechler, 2007)

Research methods



- Literature study
- Explorative semi-structured interviews
- Document study, e.g.
 - Product folders
 - Requirements template
 - Release documents
- Meta modeling
 - Process deliverable diagram (Weerd & Brinkkemper, in press).

Validity



- **Yin (2003) Guidelines**
 - For situational factors: Guided by list of factors from literature
 - For processes: Guided by structure reference framework
- **Multiple triangulation**
 - Multiple observers
 - Documents
- **Chain of evidence**