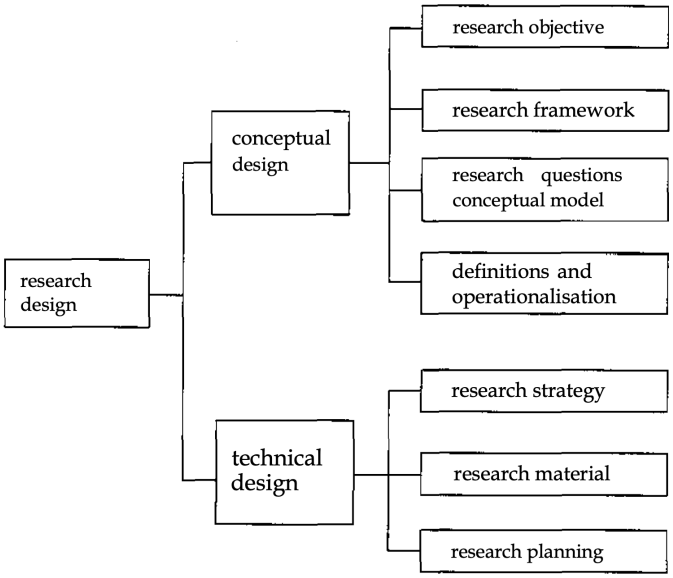
Research and Design Methodology Notes

Chapter 1: Project Design

Project Design

Two sets of activities of designing research:

1. Conceptual Design
2. Technical Research



Conceptual Design

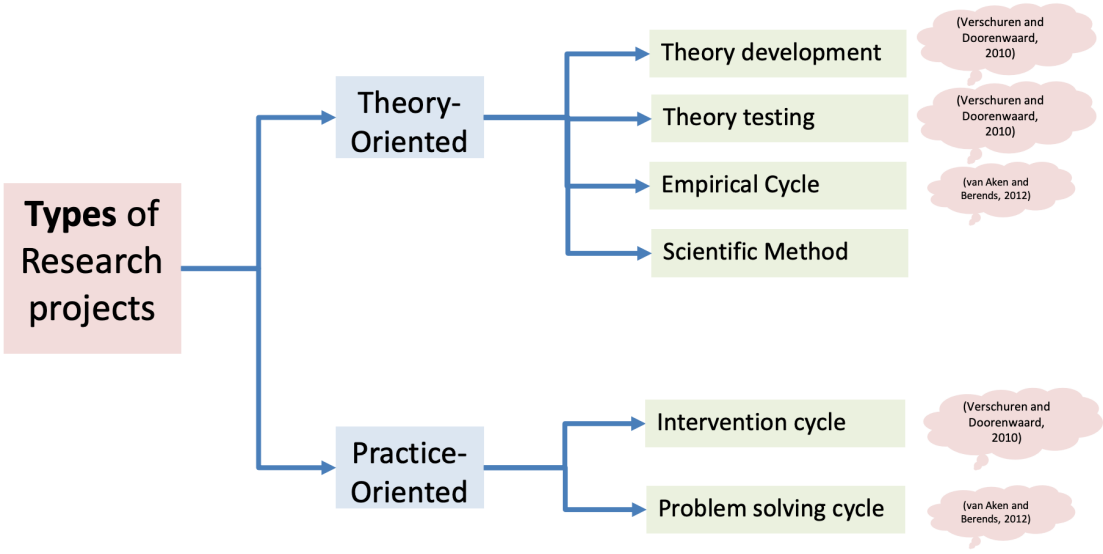
- Determining everything you wish to achieve through the research project.
- Four elements of conceptual design:
    1. *Objective* of the research project is formulated (goal of the research).
    2. This research objective must be derived from and embedded in what we will be referring to as the project context.
        - A draft of the research is developed into a *research framework.*
        - **Research framework:** consists of a schematic representation of the most important research phases
    3. Formulate a set of *research questions*.
        - Theoretical framework often takes the form of a *conceptual model*.
        - Theoretical framework = research perspective

- **Conceptual model:** the theoretical framework of the research project, and it consists of a set of assumed relationships between the core concepts of this project.

4. Defining and operationalising the key concepts.
    - Defined core concepts are translated into observable phenomena.

Technical (Research) Design

- Consists of the decisions concerning how, where and when we are going to do our research.
    1. Selection of the research strategy
        - Is the researcher looking for breadth or depth?
        - Will he or she follow a quantitative or qualitative approach?
        - First-hand observation or an analysis of information or data produced by others?
    2. Research material generation, data gathering
        - Where is this research material to be found, or how can it be produced?
    3. Preparing a clear and consistent research plan



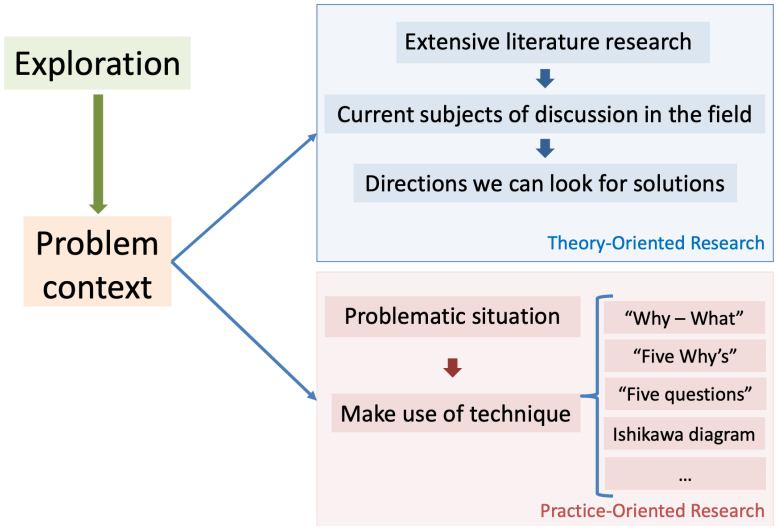
Chapter 2: Research Objective

How to formulate a research objective?

1. Exploration
    - What problems are involved?
    - What is the background?
    - What are the stakeholders' desires?
2. Formulation
    - The researcher should position their research with respect to time and space.

Exploration

- Sets the problem context.



Reasons of failure in this stage:

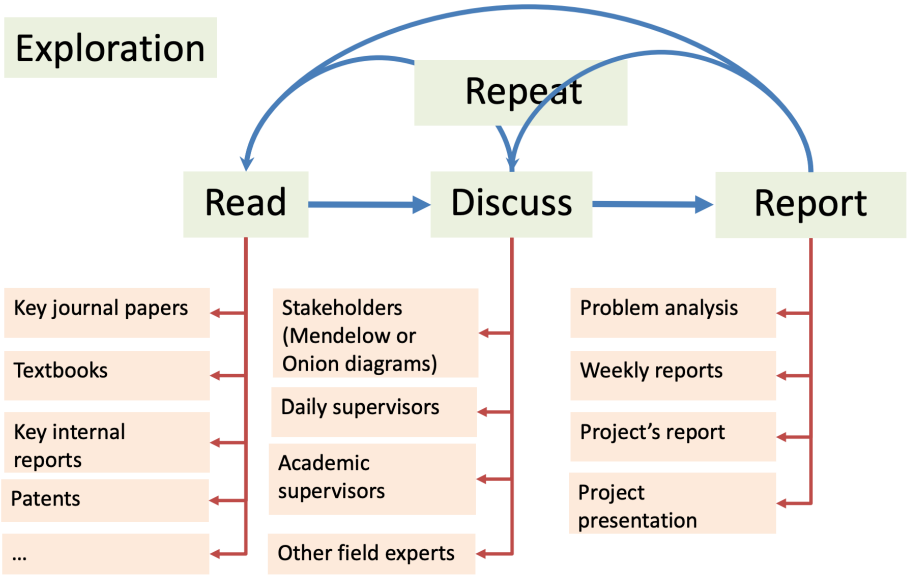
- Not being methodical
- Lack of commitment to solve the problem
- Misinterpretation of the problem statement
- Lack of knowledge of the techniques and processes involved in problem solving
- Using inappropriate method to a particular problem
- Insufficient or inaccurate information to combine analytical thinking
- **Solution:** A proper problem statement.

Problem Statement

- It is a concise description of the issues that need to be addressed before trying to solve the problem.
- Its purpose is to focus the attention of the problem solving team or individual.
- Ill-defined problems are complex because it is difficult to define each of the elements of the problem context.

Part B

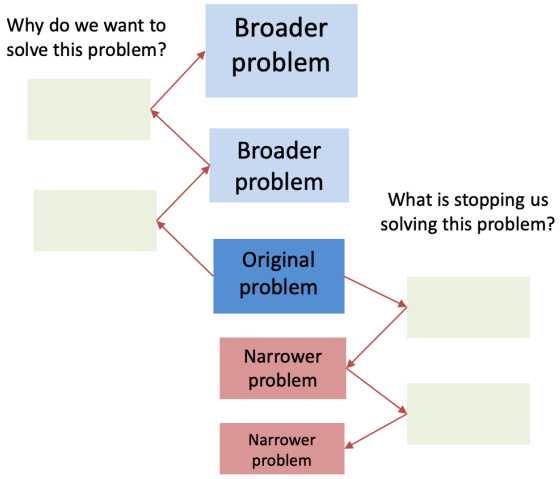
How to formulate a problem statement?



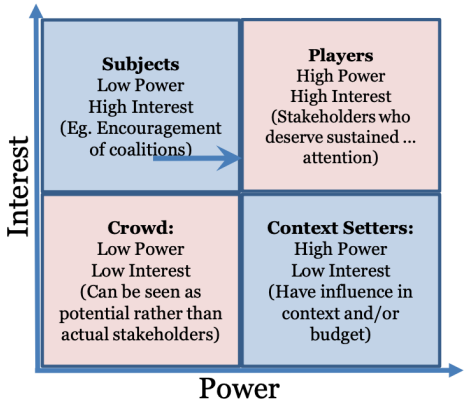
Tools for Problem Analysis in the Exploration Phase

- **Fishbone Diagram**
  - Identifies possible causes for an effect or problem.
  - Structure findings after:
    - Interviews,
    - exploring literature,
    - Brainstorming sessions.
  - The structure consists of categories.

- **"Why - What?" Analysis Model**
  - Identify **broader** problem context by understanding **why** we want to solve the problem.
  - Understand the **narrower** problem context by understanding **what** is stopping us from solving the problem.

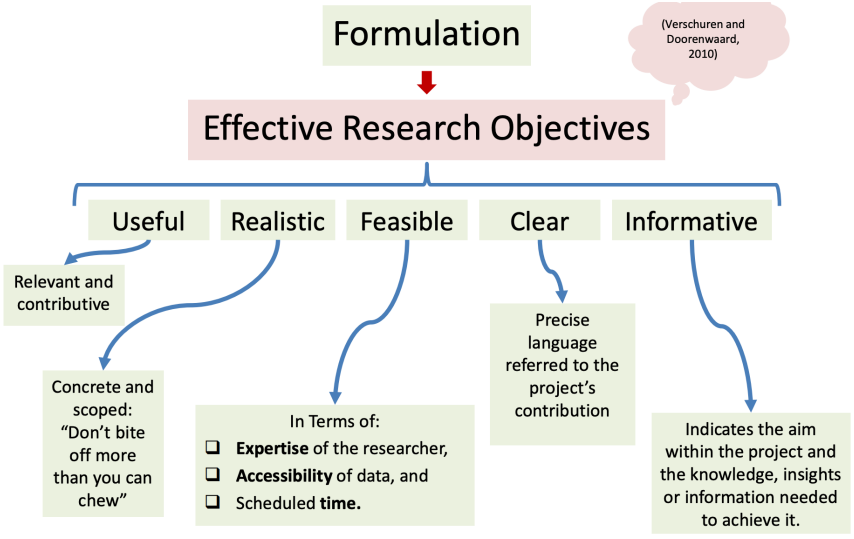


- **Stakeholder Analysis**
  - ***Stakeholders:*** Parties that have stakes in the project whether with high interest or high power.
  - Desires need to be translated into technical specifications.
  - Technical specifications (precise definitions) must be in terms of:
    - Numbers
    - Physical quantities
    - KPI's
    - Technical specs: mechanics, electric, mechatronic, electronics, process, …
  - **Mendalow's Diagram:**



Part C

Effective Research Objective



Smart Research Objective

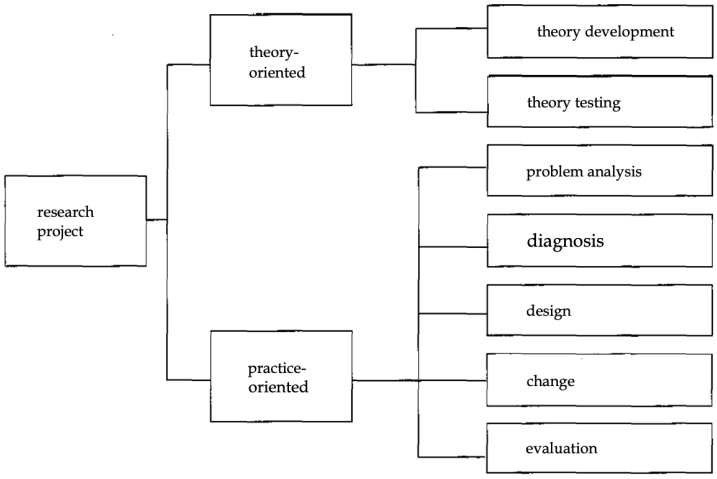
- → First step when defining a SMART goal
- → Second step when defining a SMART goal
- The smart method shouldn't be followed blindly and shouldn't be box ticking. Instead use a two-step plan.

Specific	**M**easurable	**A**ttainable	**R**elevant	**T**ime-bound
Aim for a specific area of improvement	Quantify or at least suggest an indicator of progress	An achievable goal is one that can be reasonably met with existing resources. Sometimes attainable becomes assignable and is more connected to relevant.	Relevance should be given for whom and why. Sometimes relevance is exchange by realistic and becomes closer to achievable.	Includes a reference date for completion, a timeline.

Notes from P. Verschuren en H. Doorewaard, Designing a research project, The Hague: Eleven International Publishing, 2010.

- An informative research objective makes two things clear:
  - (a) what one can and cannot expect from the results of the project,
  - (b) a general idea of the research activities involved

- After having formulated the (a)-part of the research objective, you should add the connecting word '...by ...'. This introduces the (b)-part in which you indicate roughly the knowledge, information and insight that will be needed in order to meet the expectations you formulated in part (a).
- “an ounce of prevention is worth a pound of cure” when it comes to narrowing the research objective.



- ***Theory-oriented research*** is all about solving a problem encountered in the theory development in a particular scientific area, and within this area, with regard to a specific issue.
    - ***Theory-development research*** is developmental research due to an existence of gaps in the construction of a theory or the need for a new theory or a complementary part of a theory to be developed.
    - ***Theory-testing research*** existing views are tested, adjusted if necessary and/or refined.
- ***Practice-oriented research*** is meant to provide knowledge and information that can contribute to a successful intervention in order to change an existing situation.
    - ***Problem analysis*** brings the problem into the open so that it becomes transparent and can be discussed by all stakeholders.
        - Also known as 'agenda setting'.
        - At this stage, it should be made clear what the exact problem is, why it is a problem and whose problem it is.
    - ***Diagnostic stage*** is the examination of the background and the causes of the identified problem.
    - ***Design*** is an intervention plan that can be developed in order to find a solution for the problem.
    - ***Intervention/change*** is a course of intervention or change needs to be set in motion.
    - ***Evaluation*** verifies whether the implemented changes have actually solved the problem.

Chapter 3: Research Framework

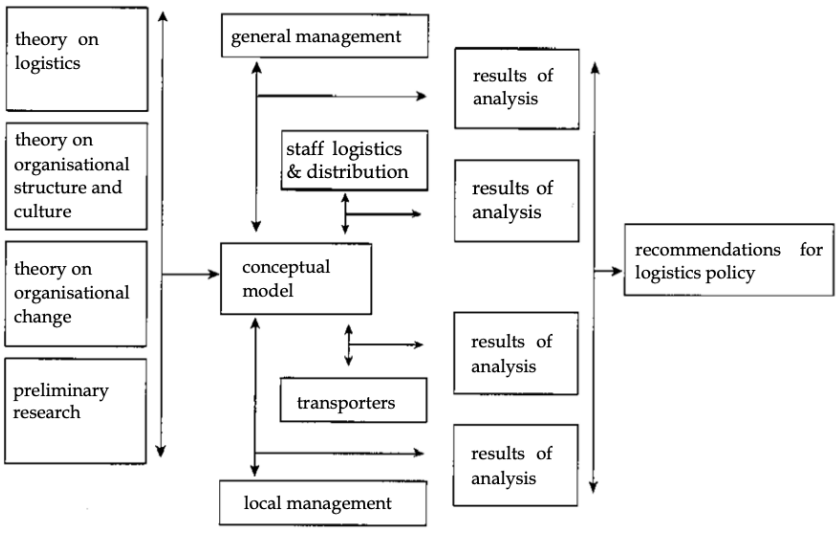
- Research framework is an intermediary step between the research objective and the research questions.

Creating Research Perspective

- **Fundamental Research**
  - Theory-developing research
  - Theory-testing research
- **Engineering-based Research**
  - Problem-analysing research
  - Diagnostic research
  - Design-oriented research
- **Social Sciences Research**
  - Intervention oriented research

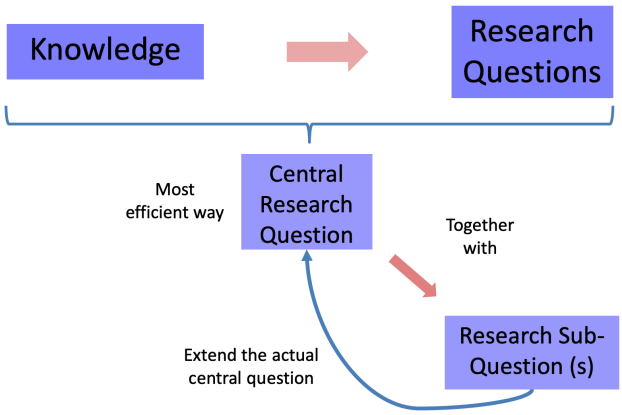
Notes from P. Verschuren en H. Doorewaard, Designing a research project, The Hague: Eleven International Publishing, 2010.

- A ***research framework*** is a schematic representation of the research objective and includes the appropriate steps that need to be taken in order to achieve it.



Chapter 4: Research Questions

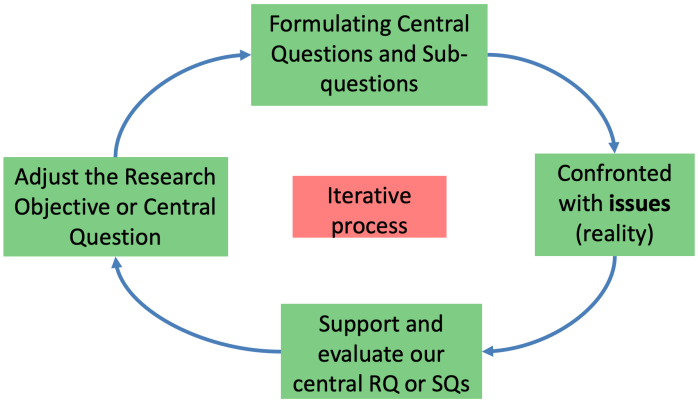
- Research questions can be divided into sub questions.
- 1 or 2 central questions and a series of sub questions (3-6)
- Each sub question is meant to gather knowledge inspired by literature.
- Knowledge is gathered through the research questions.



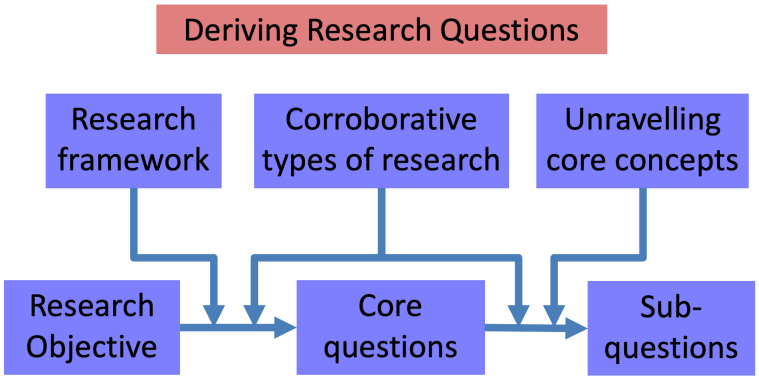
- The central questions and the sub questions are not exactly the same as the questions that are asked to the stakeholders via the stakeholder analysis.
- The stakeholder analysis is a toll to understand the desires and the technical requirements of the stakeholders.
- The research question has two main requirements:

Efficiency	**Steering Function**
- Degrees of knowledge - Answers - Contribution	Throws light on the activities.
Refers backwards	Refers forward

- The steering function is connected to the knowledge which can be ***descriptive*** or ***explanatory***.
- The questions help to decide which material (data) needs to be gathered.
- Formulating the research question is an iterative process.



- Deriving the research questions makes use of the research framework and the research objective to deduct the core questions in an iterative process. Then the sub-questions are formed through the collaborative types of research and unravelling core concepts.



- **Problematic types of questions:**
- ***"How can?"***. "How can" type of questions "say more about the research objective than about the knowledge to be acquired, i.e. the set of research questions." These types of questions are just paraphrased research objectives. Hence, they should be avoided!
- **"To what extent?"** questions
    - Provides insufficient information (knowledge)
    - The research cannot get any further

Chapter 5: Defining Concepts

- Defining concepts helps plan strategies and come up with methods to gather information.

How to reach appropriate descriptions of concepts?

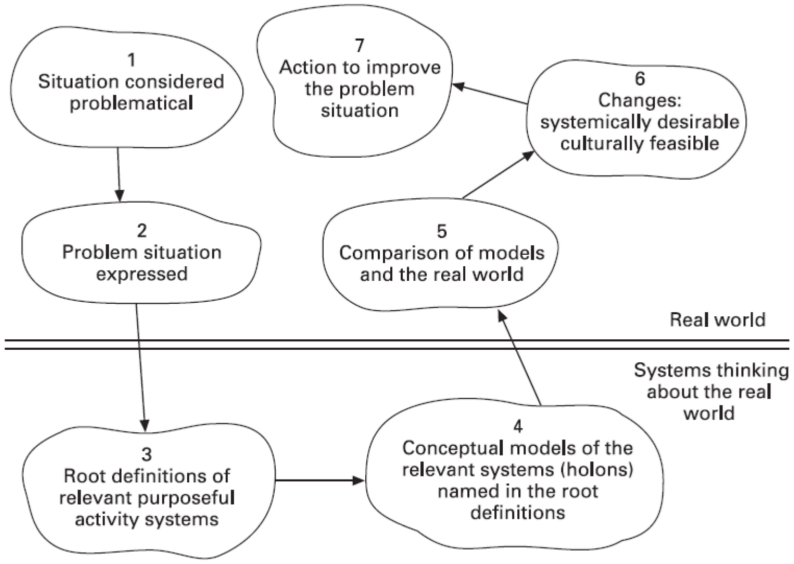
Stipulative concepts (definitions)

- They aren't correct or incorrect. They differ from the other definitions but they can be useful for the understanding of the research objective.

Stipulative Definitions		
Delineation	**Observable (operationalising)**	**Linking up to the research objective**
Size and feasibility to obtain answers.	Accurate indicators (specs)	Research questions

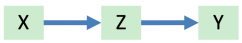
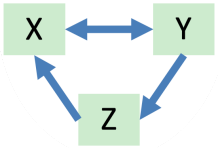
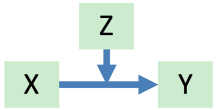
Conceptual Modelling

- Set of assumed causal relationships between core concepts of a research project.



- Conceptual modelling can be any of these or a combination of these three elements:
  1. Descriptive of nature: shows relationships between objects, variables and entities of a system.
  2. Casual models show only casual relationships.
  3. Abstractions and simplifications of reality.

Basic patterns of casual relationships:

An indirect effect of X on Y, with Z as an intervening variable	A direct effect of X on Y	An indirect feedback effect from X on Y, via Z	An interaction effect of X on Y, with Z as an interacting variable	A direct feedback effect between X and Y
				

Necessary Literature Notes

M. B. Bjerke en R. Renger, „Being smart about writing SMART objectives," Evaluation and program planning, pp. 125--127, 2017.

Specific
Measurable
Attainable
Relevant
Time-bound

- One size fits all approach for writing SMART objectives is misleading.
- Users may "blindly" follow the recipe-like method to develop SMART objectives without fully understanding the underlying reasons.
- SMART may become a "necessary box needing to be checked to fulfill a sponsor's request" instead of utilizing it properly.
- The self-assessment tool needed to be modified so the CRCs
    - (i) initially apply the criteria specific, measurable, and relevant to their objectives
    - (ii) then gather baseline data (because measurable has been defined)
    - (iii) finally add to the objective quality by applying the achievable and timely criteria
- One step SMART approach is misleading, hence, a step by step SMART approach should be applied.

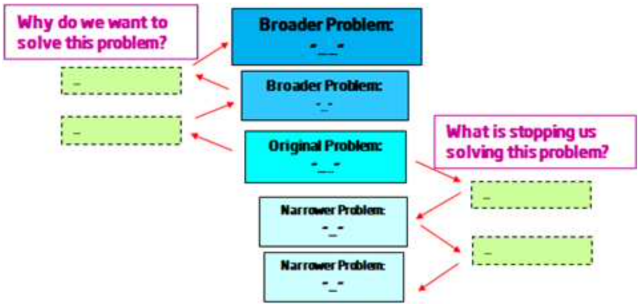
G. T. Doran, „There's a S.M.A.R.T. way to write management's goals and objectives," Management Review, vol. 70, nr. 11, pp. 35--36, 1981.

- Managers and company officers talking in terms of objectives is a characteristic of managerial excellence.
- Most managers don't know what objectives are and how they can be written.
- Objectives can be intimidating on a humane level since it sets timelines for tasks.
- The objectives must be specific, measurable, achievable, realistic and time related. However, this criteria does not specify that all objectives must be quantified on all levels of management.
- "The establishment of objectives and the development of their respective action plans are the most important steps in a company's management process."

N. Annamalai, S. Kamaruddin, I. Abdul Azid en T. Yeoh, „Importance of problem statement in solving industry problems," Applied Mechanics and Materials, vol. 421, pp. 857--863, 2013.

- Problem statements: a form of natural language used in any problem solvings.
    - described in terms of scope, structure and its purpose
- **Reasons to fail finding effective solutions:**
    - not being methodical
    - lack of commitment to solve problem
    - misinterpret problem statement
    - lack of knowledge of the techniques and process involved in problem solving
    - using method inappropriate to particular problem
    - insufficient or inaccurate information to combine analytical thinking
- **Steps in the problem process:**
    - discovery of the problem
    - the decision to tackle the issue
    - understanding the problem
    - researching the available options and taking actions to achieve your goals
- **The problem solving process is a cycle:**
    - (1) perceptually recognizing a problem
    - (2) considering relevant information that applies to the current problem
    - (3) identify different aspects of the problem and lastly describe the problem.
- The research-worthy problem statement should address all six questions: what, how, where, when, why, and who.
- The ***problem space*** contains three elements:
    1. a problem state, which is the information the problem solver, knows about the problem;
    2. a goal state, which constitutes the solution to the problem;
    3. a search space, which consists of all the strategies that may be employed to solve the problem.

- Strategies to navigate the problem space:
    1. **Algorithms**
    - Strategies that guarantee a result, with a mathematical formula being an example of an algorithm.
    - Useful for problems where it is possible to identify all features of the problem space clearly.
    2. **Heuristics**
    - Strategies that improve the chances of solving a problem, but cannot guarantee a solution.
    - Complex problems are most often solved using heuristics.
    - Types of heuristics:
        1. **Forward reasoning**
            - Strategies involve the problem-solver making a smooth traversal from problem state to goal state.
        2. **Backward reasoning**
            - Involves trying out strategies and monitoring whether they have moved the problem closer to the goal.
- Performing What & Why Analysis Model will give clear amplification to the importance of solving the problem.
- The What-Why Analysis model requires substantial investment in time and resources, due to its extensive scope and evolution.



System Thinking

Why systems language?

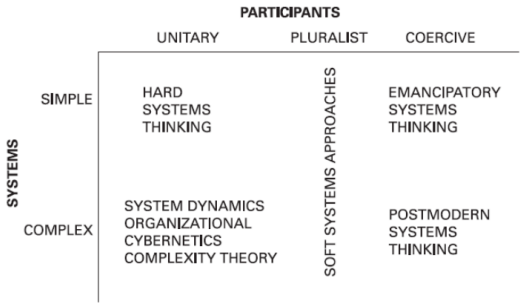
- Emphasis on holism offers a useful corrective to the reductionism
- Emphasis on process as well as structure
- Transdisciplinary
- Suitable for getting to grips with real-world problems

Soft System Thinking

- Problem contexts are pluralist and provide recommendations for analysis and intervention on that basis.
    - ***Pluralist:*** the stakeholders don't have any common goals.
- The notion that it was possible to assume easily identifiable, agreed-on goals is abandoned.
- Notion that could not be used to provide an objective of the system and its purposes.

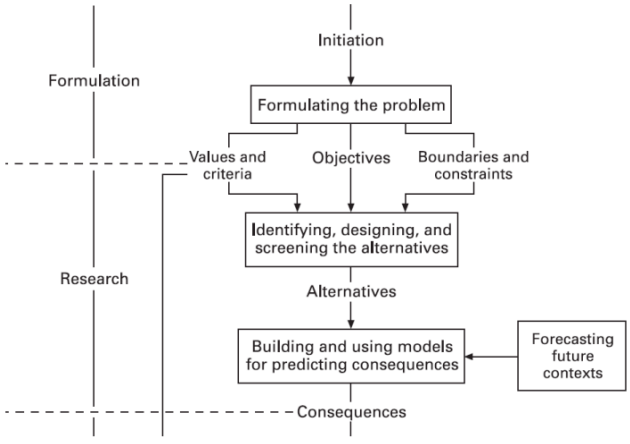
Hard System Thinking

- Participants defined as being in a unitary relationship have similar values, beliefs and interests. They share common purposes.
- Problem contexts are not extremely complex.



The systems analysis methodology:

Formulation and Research



Chapter 6: Research Strategies

Research Strategy

- ***Research strategy:*** the coherent body of decisions concerning the way the researcher is going to carry out the research. Gathering relevant material and processing this material into valid answers to the research questions.
- A set of key decisions from which a number of other decisions will follow.
    1. Breadth or Depth
    2. Quantitative or Contemplative (Qualitative)
    3. Empirical researcher of Desk researcher

Breadth or Depth

Breadth: A large-scale approach which enables a generalization of the results

Depth: Aim for a small-scale approach that yields knowledge that can be generalized to a lesser extent

- Minimize the risk of uncertainties

Quantitative or Contemplative (Qualitative)

Quantitative: Research findings are compiled in tables, charts, numbers, calculations, ...

Qualitative: A more the contemplative interpreting approach

- Reporting is mainly verbal and contemplative

Empirical researcher of Desk researcher

Empirical researcher: Do research in the field, gathering data herself to make judgements based on the analysis of these data

Desk researcher: Make use of existing literature or data gathered by others

Other decision that should be taken:

- What is the number and the type of research units to be selected and how to select them?
- How to make the choice of sources and what methods will be used to open them up?
- What is the path in which the data and literature are going to be processed into answers to the set of research questions?

Major Strategies to be used for the Research Project

- Desk research
- Grounded theory approach
- Surveys
- Case studies
- Experiments

Step by step approach

1. Decide breadth or depth
2. Decide quantitative or qualitative
3. Determine empirical or non-empirical

4. Select one (or more) of the research strategies
5. Select one of the variants of the research strategies

Notes from P. Verschuren en H. Doorewaard, Designing a research project, The Hague: Eleven International Publishing, 2010.

- ***Survey:*** A research strategy in the course of which the researcher tries to gain an overall picture of a

comprehensive phenomenon spread out over a stretch of time and/or space.

- ***Experiment:*** A research strategy for acquiring experience with newly created situations or processes, an experience which can be used to assess the effects of these changes.
- ***Case studies:*** A research strategy in which the researcher tries to gain a profound and full insight into one or several objects or processes that are confined in time and space
- ***The grounded theory approach:*** A strategy that can be used to gain theoretical insights with only the minimum of prior knowledge, and by continuously comparing phenomena that are involved.
- ***Desk research:*** Desk research is a research strategy in which the researcher does not gather empirical data herself or himself, but uses material produced by others.

Chapter 7: Research Material

Data sources

- Gathering data
- Generating data

Researcher

Complex issues to address:

- Confront abundance and diversity
- Being resourceful
- Make choices
- Flexible choices
- Set of (sub)questions could be redefined
- Be aware of pros and cons

Data

- **Sources**
    - **Research objects**
        - Empirical or deterministic objects
    - **Types of information**
        - Facts or knowledge
    - **Where can the information be gathered?**
        - Sources may in itself also be the research objects
- Seven types of sources:
    1. People
    2. The media
    3. Reality (direct measurements- experiments)
    4. Documents
    5. Literature
    6. Previous set of data (other institutions)
    7. Simulations

- **Accessing the data**
    - Questioning
    - Observation
    - Measuring instruments
    - Content analysis
    - Search method

A step by step approach

1. For each RQ and RSubQ determine research object and types of information
    - For each research object

2. Determine which and how many sources are required
    - For accessing sources
3. Determine which methods will be used
    - Iterate and confront with: RQs, R. Objective, and definition of key concepts

Notes from P. Verschuren en H. Doorewaard, Designing a research project, The Hague: Eleven International Publishing, 2010.

- Before gathering the relevant information to answer the research questions one needs to know the objects about which data will be gathered and the type of information. Answer these questions:

1. What are the main categories of research objects that can be distinguished?
2. What types of information on these objects are relevant to the research project, and how can this information be identified?
    a. Data/facts;
    b. Knowledge.
3. Where can this information be gathered or how can it be generated?

5 types of sources:

1. People (especially in social policy and management science)
    a. Can provide very wide diversity of information;
        i. When providing information about themselves respondent (data)
        ii. When providing information about someone else informant (data)
        iii. He or she supplies knowledge to experts. (knowledge)
    b. Can be gathered relatively quick (speed)
        i. Informants will be able to bridge distances in places and time;
        ii. One can tap into information/ does not have to wait for something to happen like when watching a process or studying documents.
2. The media;
    a. Internet, be warned: Amateurs publish as well;
    b. Wide geographical scope;
    c. High information density;
    d. High level of topicality (relevance).
3. Reality, high objectivity → no channel of expression/interpretation;
    a. Direct, measurements on object directly (duration of production process or length of person);
    b. Indirect measurements on (e.g.) interior or building can give information on preferred walking routes of employees.
4. Documents;
    a. Resemble the recorded media, however they differ in that documents are addressed to a specific public, whereas the media is addressed to a wider and under defined public;

   - **b.** Large amounts are available and can turn into a disadvantage, overwhelming amount of information.
5. Literature.
   - **a.** First source to look for;
   - **b.** Knowledge source, contains theoretical connections between;
   - **c.** Data source, if the literature consists of objective descriptions of reality.

5 methods for extracting information from a source:

1. Questioning
   - **a.** Poll or interview, difference:
     - **i.** The degree to which the interview has been pre-structured;
     - **ii.** The degree to which the set of research questions is open.
   - **b.** Poll: high degree of pre structuring & closed questions
   - **c.** Interview: vice-versa
2. Observation
   - **a.** Pre structured vs open variant, difference parallel between poll and interview;
   - **b.** Pre structured: observational categories have been subdivided and described in advance.
3. Measurements instruments
   - **a.** Direct measurements in real life situations.
   - **b.** Both quantifying (length) and qualifying (catholic)
4. Content analysis
   - **a.** By means of the category system. Similar to a questionnaire.
   - **b.** System can range from rough to precise categorisation;
   - **c.** Also quantitative and qualitative types of content analysis.
     - **i.** Qualitative: extract information from a large amount of textual material that is relevant to the researcher.
     - **ii.** Quantitative: researcher focuses on importance of certain subject matters, statements or approaches based on quantitative indications (how often, how much, how long).
5. Search method
   - **a.** Search indices
     - **i.** Card indices boxes
     - **ii.** Nowadays electronic indices, (far more efficient)
   - **b.** Extracts and reviews
   - **c.** Reviews/volumes of specialist journals
   - **d.** Snowball principle for finding relevant publications
     - **i.** Bibliography of first publication is studied thoroughly
     - **ii.** From bibliography to bibliography.
     - **iii.** Judge on the table of contents.

Chapter 8: Research Planning

Research Design

- What?
    - Research objective
    - Set of research questions
- How?
    - Research strategy
    - Research material
        - How can the research material be analysed and the results reported?

What is the wrong conceptualization of planning?

- A time schedule with just a list of activities to be carried out
- Setting out the dates on which the activities should be done
- Dates seeing as definite deadlines
- Planning becomes the objective in itself

What is the correct conceptualization of planning?

- An overview of activities
- Their intermediate and end products (deliverables)
- Their sequence and timeline
- Planning is a combination of processes and their products

Functions of research planning

Formative monitoring function

- It is a type of time keeper.

Design Functions

1. Provides an overview
    - Questions
    - Strategies
    - Materials
2. When and which order
    - Serial
    - Parallel

A step by step approach

1. Make an activity plan
    - Connected to activities
2. Draw up a time schedule
3. Create a time-axis
4. Draw up an histogram (Gantt Diagram)
    - Establish the critical route
5. Compile the table of contents

Notes from P. Verschuren en H. Doorewaard, Designing a research project, The Hague: Eleven International Publishing, 2010.

Step 1: Activity Plan

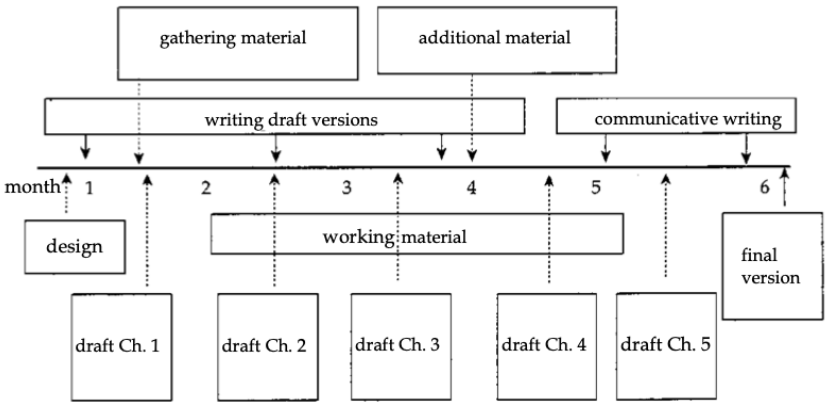
1. Designing the research project
2. Research preparation
3. Specifying the research perspective
4. Gathering research material
    a. Questioning
    b. Observation
    c. Content analysis
    d. Search methods
5. Reporting and initial analysis
6. Feedback
7. Development of the material
8. Gathering of additional material
9. Draft chapters
10. Products

Step 2: Time schedule

- The research perspective is developed simultaneously when preparing the research project.

Step 3: Time-axis

Figure 8.2 Time-axis representing a planning



Necessary Literature Notes

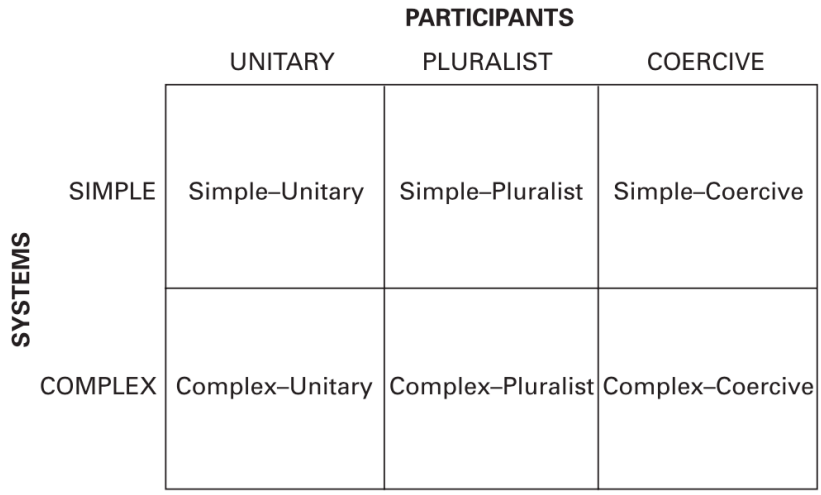
M. C. Jackson, „Systems thinking: Creative holism for managers," in Systems thinking: Creative holism for managers, West Sussex, UK, John Wiley & Sons, Ltd, 2003, pp. Only Chapters 1, 2, and 4.

Chapter 1

- ***System***: a complex whole the functioning of which depends on its parts and the interactions between those parts.
- Different types of systems:
    - physical, such as river systems;
    - biological, such as living organisms;
    - designed, such as automobiles;
    - abstract, such as philosophical systems;
    - social, such as families;
    - human activity, such as systems to ensure the quality of products
- ***Reductionism*** sees the parts as paramount and seeks to identify the parts, understand the parts and work up from an understanding of the parts to an understanding of the whole.
- ***Holism*** considers systems to be more than the sum of their parts.
- The term ***'stakeholder'*** is used to refer to any group with an interest in what the system is doing.
- ***Decision-makers*** or owners have the power to make things happen in systems; actors carry out basic tasks; customers or clients benefit or su¡er from what a system does.
- ***Problem-owners*** worry about the performance of some aspect of a system.
- ***Witnesses*** are affected by systems but unable to influence their behavior.
- ***Complexity theory:*** The fact that so many complex systems appear to exhibit disorder, irregularity and unpredictability had seemed to put them beyond the reach of scienti¢c understanding.

Chapter 2

- ***Systems methodology:*** When systems practitioners bring together various systems ideas and techniques in an organized way and employ them to try to improve a problem situation.
- Weaknesses of hard systems thinking:
    - inability to handle significant complexity
    - to cope with a plurality of different beliefs and values
    - to deal with issues of politics and power
    - unable to deal satisfac- torily with multiple perceptions of reality
- the 'systems' managers have to deal with, as they become larger and subject to more turbulence;
- the 'participants', those with an interest in the problem situation



- Participants defined as being in a ***unitary*** relationship have similar values, beliefs and interests.
- Those defined as being in a ***pluralist*** relationship di¡er in that, although their basic interests are compatible, they do not share the same values and beliefs.
- Those participants defined as being in ***coercive*** relationships have few interests in common and, if free to express them, would hold conflicting values and beliefs.
- With complexity theory it is ***'strange attractors***' and the variables that have to be adjusted to ensure that an ***'edge of chaos'*** state is achieved.
- Soft systems thinking fails to respond appropriately because of its pluralist bias that consensus, or at least accommodation, between di¡erent stakeholders can be achieved.

Chapter 4

Type A: Improving Goal Seeking and Viability

- These approaches are hard systems thinking, system dynamics, organizational cybernetics and complexity theory

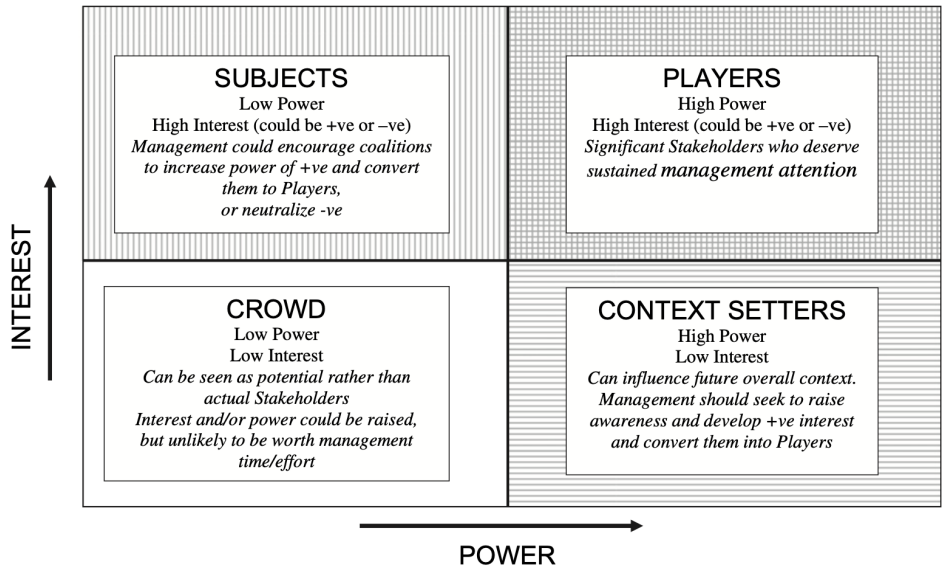
Hard Systems Thinking

- Its primary purpose in hard systems thinking is to serve the interests of clients, managers, decision-makers, policy-makers, etc., not to bring about the advancement of knowledge for its own sake.
- In hard systems thinking scientists are required to address real-world problems and the solutions they produce must work in the operational domain, not in the laboratory.
- Iit is usually too costly or simply unethical to carry out experiments using large sociotechnical systems.

- Models, in hard systems thinking, are designed to capture the essential features of the real world.
- Models are so crucial in hard systems thinking because they aim to capture as accurately as possible the workings of the system underlying the problems being investigated.

F. Ackermann en C. Eden, „Strategic management of stakeholders: Theory and practice," Long range planning, vol. 44, nr. 3, pp. 179--196, 2011.

- Three methods to to both identify and manage those stakeholders:
    1. Identifying who the stakeholders really are in the specific situation (rather than relying on generic stakeholder lists). Recognising the uniqueness of an organization's context and its goals allows managers to identify specific stakeholders and be clear about their significance for the future of the organization;
    2. Exploring the impact of stakeholder dynamics; acknowledging the multiple and interdependent interactions between stakeholders (and potential stakeholders);
    3. Developing stakeholder management strategies; determining how and when it is appropriate to intervene to alter or develop the basis of an individual stakeholder's significance, which itself is determined through in depth consideration of stakeholder's power to, and interest in, influ- ence the organization's direction.



Three types of stakeholders:

1. Those with interest but little power ('subjects')
2. Those with power but little interest ('context setters')
3. Those key stakeholders who have both ('players')