ESCUELA POLITÉCNICA NACIONAL

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Tablas

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Monday	11C	22C	A clear day with lots of sunshine. However, the strong breeze w
Tuesday	9C	19C	Cloudy with rain, across many northern regions. Clear spells ac
Wednesday	10C	21C	Rain will still linger for the morning. Conditions will improve by

With width specified:

Day	Min Temp	Max Temp	Summary
Monday	11C	22C	A clear day with lots of sunshine. However, the strong breeze will bring down the temperatures.
Tuesday	9C	19C	Cloudy with rain, across many northern regions. Clear spells across most of Scotland and Northern Ireland, but rain reaching the far northwest.
Wednesday	10C	21C	Rain will still linger for the morning. Conditions will improve by early afternoon and continue throughout the evening.

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- ¿Dónde se sitúan normalmente las tablas en un libro correctamente diseñado?

Table 3.1 Research design decisions (Adapted from [38])

Spectrum	One end of continuum		Other end of continuum
Method	Qualitative	vs.	Quantitative
Aim	Exploratory	vs.	Explanatory
Boundary	Case	vs.	Statistical
Setting	Field	vs.	Laboratory
Timing	Cross-sectional	vs.	Longitudinal
Outcome	Descriptive	vs.	Causal
Ambition	Understanding	vs.	Designing

observations, induction and deduction. These three themes can be utilised to reflect upon your research design (does it involve an appropriate way to rationalise? To validate? To explore?).

Through the perusal of the framework in Fig. 3.1, it is evident that research design is the outcome of a process with many choices. These choices are not trivial and their implications regarding what the potential and likely research outcomes will be are significant. Table 3.1 summarises some of the important design decision parameters. Note that by no means are these decision binary (either-or) in nature; rather, they exist as two key points along a continuum of choices.

The rows in Table 3.1 describe different spectra by which we can examine research design choices. For instance, the first row may relate to the design spectrum "method" and considers qualitative versus quantitative modes of inquiry. The aim of a piece of research, similarly, may fall between exploration and explanation or a combination thereof. The boundary of the research might be limited to a particular case (such as an interesting case of an organization or an individual) or by statistical properties (such as the required sample size for a survey or experiment). The focus of the timing might be one case over time (longitudinal) versus at several cases at one point in time (cross-sectional). Again, there might be other variations such as several cases over time or one case at one point in time. Our research outcomes might focus on descriptions of a previously undiscovered phenomenon or rather on the discovery of certain causal mechanisms that explain why a phenomenon manifests the way it does. The ambition, finally, might be to understand a problem or situation or to design a solution or a novel artefact.

I wrote above about the criticality of the research question, and I will repeat it here: The key benchmark against which your research design must be aligned is the problem statement as specified in the research question(s).

One key downfall of doctoral students is the "*I do research method X syndrome*". When asking students about their research, I often receive statements such as "I'm doing case study research", or "I do design science", or "I'm doing a survey". In all these cases, the students focus on a singular aspect of their research design – the choice of a research method – independent from the projected research outcome or the research question they seek to answer.

Let's put it straight: the research question determines, at least to a large extent, the choices required in selecting a research design. It dictates whether a more

qualitative, interpretive inquiry is warranted or whether a more quantitative, statistical examination is the more appropriate strategy.

One of the key design choices in research design relates to the use of the **research methodology**. We will return to this challenge in Sect. 3.3 below. At the same time, research design needs to account for several other considerations. The most important ones I will summarise as follows:

- **Data**: What type of data is required? Where can I collect observations or other forms of evidence? How will I sample the relevant data?
- **Risks**: What are the potential dangers associated with execution of the research design? For example, what is the likelihood of a case organisation not being available for study anymore? What are strategies available to minimise or mitigate these risks?
- **Theory**: Which and how much literature concerning the phenomena of interest is available? Where are gaps in the knowledge base? What findings have been produced to date that might have an impact on my work and influence choices in my research design?
- **Feasibility**: can the research design be executed within the constraints associated with a doctoral study such as time limitations, resource limitations, funding, experience, geographic boundaries, and others?
- **Instrumentation**: how will my constructs of interest be measured? Will my construct operationalisation be appropriate given the choice of research methodology and set of data available?

In selecting a research design, progress may be evaluated by examining whether (a) you have appropriate answers to the questions above, and (b) you maintain alignment to the type of research problem that is specified in the research question. The alignment does not necessarily need to be unidirectional (from the question to the design); in fact, in most cases it is observed that research questions, over time, get tweaked and altered to reflect an updated research design, and still, research questions should retain prominence over and above the research design. In our research efforts, we set out to answer an important question; it is not appropriate to find an answer and then devise a question that fits the answer.

In making research design decisions, students, together with their supervisors need to select research designs that they feel comfortable with and in which they have experience. There is logical validity to such an approach. This is not to say that new research designs should be abandoned and not pursued. Still, many doctoral problems I witnessed originated largely from the fact that neither the student nor the supervisory team had any experience with a particular research design (say, based on a survey strategy). The execution of such studies is then unnecessarily hard because resources to give meaningful feedback based on experience are necessarily limited if available at all.

3.3 Research Methodology

Hand in hand with the development of a research design is the selection of the appropriate research methodology. Most scholars would even argue that the selection of a research methodology is the most important design choice in the research process.

Research Methodology is a term that describes the **strategy of inquiry** used to answer a specific research question. Creswell [40] states that strategies of inquiry are "types of qualitative, quantitative and mixed methods designs that provide specific direction for procedures in a research design". I agree with him, but will also add design science methods as an additional orthogonal strategy of inquiry to his list:

- **Quantitative Strategies** are procedures that feature research methods such as experiments or surveys and which are characterised by an emphasis on quantitative data (think of these procedures as having a focus on "numbers").
- **Qualitative Strategies** are procedures that feature research methods such as case study, ethnography or phenomenology and which are characterised by an emphasis on qualitative data (think of these procedures as having a focus on "words").
- **Mixed Methods** are procedures that feature combinations of both qualitative and quantitative strategies in either sequential or concurrent fashion (think of these procedures as having a focus on "numbers and words").
- **Design Science Methods** are procedures that feature methods to build and evaluate novel and innovative artefacts (such as new models, methods or systems) as the outcome of a research process and which are characterised by an emphasis on the construction of the artefact and the demonstration of its utility to an organisational problem (think of these procedures as having a focus on "artefacts").

When we leave out a mixed method strategy for a moment (because it combines characteristics of both qualitative and quantitative strategies of inquiry), we can differentiate the other three strategies alongside a number of dimensions, as summarised in Table 3.2 and discussed below.

Controllability refers to the extent to which events during a study are under the control of the researcher. In a qualitative inquiry where the researcher often enters an organisation to observe the behaviours, processes or events, controllability over what happens is comparatively low when compared to quantitative inquiries such as surveys or experiments, where control is exerted, for instance, through the operationalisation of a measurement instrument that precisely defines what will be measured and how. In design science research, control over progress and effects is typically at the hands of the person designing, i.e., the researcher.

Deductibility refers to the extent to which the strategy allows for deductive reasoning. Through the emphasis on quantitative data, quantitative strategies allow for strong deductive reasoning through statistical or other quantifiable conclusions,

Table 3.2 Differences in research strategies (Based on [66])

Requirement	Qualitative	Quantitative	Design science
Controllability	Low	Medium to high	High
Deductibility	Low	Medium to high	Very low
Repeatability	Low	Medium to high	High
Generalisability	Low	Medium to high	Low to very low
Explorability	High	Medium to low	Medium to low
Complexity	High	Medium to low	Medium to high

whereas deductibility is typically limited when doing qualitative inquiries such as single case research or ethnography. Deductibility is often extremely low in design science research because of the challenge involved in embedding hypotheses testing into the design of an artefact.

Repeatability refers to the extent to which the findings are reliable in the sense that the research procedures can be repeated with similar if not identical results. This requirement is easier to meet in quantitative inquiries where instruments of measurement tend to be more precisely defined. Repeatability can be said to be high for design science research as the artefact is typically designed to be stable and thus should lead to similar usage behaviours.

Generalisability refers to the extent to which the findings and observations can be generalised beyond the data being observed or examined. Quantitative inquires, especially surveys, provide a greater ability to generalise beyond the sample; qualitative inquiries are more deeply immersed into the context of the inquiry.

Explorability refers to the extent to which a research strategy encourages or enables the discovery of previously unknown or unconsidered observations or findings. This emphasis is typically built into qualitative inquiries through an emphasis on broad and open measurements; quantitative inquires with their precise and formalised measurements are more limited in terms of exploring beyond the focus of the study. Explorability can be an attribute of some artefact designs but more often than not exploration is not a key requirement when creating novel artefact designs.

Complexity refers to the extent to which a research design leads to comprehensive, exhaustive, and multi-facetted knowledge contributions. Quantitative inquires are characterised by a reduction of the inquiry to selected, precisely defined measurements of phenomena, whereas qualitative inquiry, through broader and more open data collection procedures, allow for more manifold findings and knowledge contributions. Complexity in design science research is greatly dependent on the type of artefact but can often be assumed to be a key characteristic of the design, based on the assumption that all simple artefacts have already been discovered and designed.

All of these criteria are usually combined in a favourable way (medium to high, for example) in mixed method designs. Depending on the choice of research methods to be combined in a mixed method strategy, the overall methodology may lean towards the characteristics of either purely qualitative or quantitative inquiries. A valuable mixed method design, therefore, is one that combines "strong"

through data but also **ruling out alternative theories**. For example, through the same process as above we may have ended up with different theories such as the following two accounts:

- The "Excellence Theory": everyone has a need to excel in one area. Achieving excellence in any one area is enough to satisfy this need. Football players satisfy their need for accomplishment through football, so they are not motivated to be smart in class.
- The "Jealousy Theory": we are jealous of others' success. When we are jealous, we subconsciously lower our evaluation of that person's performance in other areas. So we *think* football players ask dumb questions.

Note how both these rival theories are also general and fertile and generate implications for other groups of people, such as musicians or beauty queens.

To rule out alternative theories – or to choose between rival theories – we can utilise the fact that our theories are fertile and non-circular. This is because our theories can be applied to scenarios in which they are expected to hold but which would violate the implications of some (or all) of the alternative theories.

If a theory is specific enough, a situation can be plugged into the theory in order to discover what outcome would present. The idea, then, is to collect a set of situations which when applied to different theories would result in different predictions or expectations.

Consider, for example, how football players should behave (or appear to behave) in class out of season. Will they still be asking dumb questions? According to the first theory ("Limited Time Theory"), football players should not ask dumb questions out of season, because there is plenty of time to study. But according to the second theory ("Excellence Theory"), members of the football team should continue to ask dumb questions because they are still football players and still getting recognition, so they still don't feel the need to excel academically. The third theory ("Jealousy Theory") would also yield the expectation of continued dumb questions, because we are still jealous, and jealousy is not dependent on seasons.

In turn, studying football player behaviour out of season should help to distinguish between the first theory and the other two, no matter how the data turn out. If the football players appear smart out of season, then the Excellence and Jealousy theories are wrong and we can rule them out. If the football players appear dumb, then our original Limited Time theory is wrong. In that case, however, we still don't know whether Excellence or Jealousy is the better explanatory account for our observation.

What we can do in such a situation is to conceive another scenario by which we can distinguish our theories. For example, consider athletes who do not look like athletes because they are not unusually big (like football), tall (like basketball) or fat (like sumo wrestling). Would those athletes appear to ask dumb questions? The Limited Time theory will again clearly say "yes" because practice time required for these sports is unaffected by physique. The Excellence theory will also say "yes"

Table 4.2 Expectations generated by each theory for the two situations

Question	Limited time theory	Excellence theory	Jealousy theory
Do football players ask dumb questions out of season?	No	Yes	Yes
Do athletes who do not look like athletes ask dumb questions?	Yes	Yes	No

because even if people can't recognise them on the street, they are still fulfilling their need to do one thing really well so they will not feel the need to excel in class. The Jealousy theory, however, would say "no" (for most people anyway), because if the athlete is not recognizable as such (by virtue or being tall, big or fat), we would not realise the fact that we are in the presence of an athlete.

In essence, what we have done is we conjured situations in which we have different expectations as per the propositions of our theory, and we conjured sufficient situations to determine a verdict about the theories (see Table 4.2).

You should see how this set of expectations would allow us to go and precisely collect data that, upon analysis, should allow us to rule out two theories in favour of one remaining theory. In other words, we have created testable hypotheses that allow us to determine the validity of our theory.

Of course, this example is simplistic in nature, but you should still be able to learn about important principles of theorising from it. You should also have noted how in many cases we made a set of **assumptions** on which our theory is based. For one thing, we are assuming that there is a time (out of season) when football players are not consumed by the sport – which in some cases might not be true. The jealousy theory also builds on an assumption, namely that we ascribe negative characteristics to people that look like they have high social status.

4.3.2 *Practical Suggestions to Theorising*

Let us end this chapter by reviewing some general suggestions about the act of theorising. Most importantly, the suggestion is not to underestimate the significance of theorising in scholarly work. Many of the editors of prominent journals keep stressing the point that, typically, reviewers of scholarly work expect your method to be sound and rigorous, your research plan and execution is effective and appropriate. This means that you will not get a paper accepted because you executed the survey or case study method well. This is simply expected of you. Instead, papers are being inspected primarily for novelty and theoretical contribution. Detmar Straub [165], the current Editor-in-Chief of the MIS Quarterly, chose these words:

> Theory is King and it is in the evaluation of the theoretical contribution that most reviewers become convinced, or not.

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