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| **Topic 4: Theoretical Framework and Hypothesis Development** |

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| **Introduction**  |

The key areas of learning in this topic are:

* The Research Process ‘Onion’ of Saunders et al and The Honeycomb research methodology of Johanthan Wilson.
* Understand the steps involved in a research approach.
* The choice of a research approach
* The concept of research strategies in relation to the research questions and their options
* The concept of research design as distinct from data collection
	1. **Theoretical Framework in Inductive Research (an aspect of research design)**

A *theoretical framework* is a presentation of how certain variables or concepts) are related to each other and the explanation of how they are associated to each other. Draw *a model* to show their relationships and from which a theory is drawn. (In fact, the model and the theory in the research area can be derived from a review of the literature related to the research area.)

The process of building a theoretical framework involves:

1. Introducing the variables in the model.
2. Develop the conceptual model that indicates the relationships between the variables.
3. Coming up with a theory that explains the relationships between the variables in the model.
4. Hypotheses are drawn from these relationships of the variables

The hypothesized relationships are then tested through appropriate statistical analyses. This approach is known as *deductive* quantitative approach i.e. not for inductive (qualitative) approach.

In summary:

The process is as follows:

 Theoretical framework variables a model theory hypotheses

 **……………………………………………….**

* + 1. **The variables**

*What are variables?*

A variable is anything that can take on differing or varying values. This value can be different at different times for the same object or persons or at the same time for different objects or persons. Examples of variables are productive units, absenteeism and motivation.

There are ***4 types of variables***:

1. The *dependent variable* (also known as criterion variable).
2. The *independent variable* (also known as the predictor variable).
3. The *moderating variable*. (A variable that has an effect on the dependent variable and independent variable relationship.)
4. The *mediating variable*. (A variable that stands between the dependent variable and independent variable.)

Each variable can be a discrete entity (e.g. male or female) or a continuous entity (e.g. the age of an individual).

**a) Dependable variable**

This type of variable is dependent on other variables to influence its outcome or change. It is possible to have more than one dependent variable in a study such as between quality and volume of output; low-cost production and customer satisfaction; and quality and cost.

In a research study the researcher looks for the factors that influence the dependent variables such as how they change.

**b) Independent variable**

It is the one that influences the dependent variable in either a positive or negative way. When the independent variable is present, the dependent variable is also there. The idea is to find whether the change of the dependent variable is influenced by the independent variable.

However, to establish that a change in the independent variable causes a change in the dependent variable, there are four conditions to be met:

1. A change in the dependent variable should be associated with a change in the independent variable.
2. The independent variable (the cause) must precede the dependent variable. The cause must take place before the effect occurs.
3. No other factor should be a possible cause of the change in the dependent variable.
4. A logical explanation (a theory) is needed and it must explain why the independent variable affects the dependent variable.

 Independent variable Dependent variable

 (cause in t0) (effect in t1)

**c) Moderating variable**

* The moderating variable has a strong contingent effect on the independent variable-dependent variable relationship. It is a new variable constructed by the researcher to interact with the independent variable to bring about an *interaction effect*. This moderating variable is a special form of independent variable.
* It means that the presence of a third variable (the moderating variable) modifies the original relationship between the independent and dependent variables.
* The moderating variable has an interaction with the independent variable in explaining the variance.
* The moderating variable is an independent variable.

E.g. It has been found that there is a relationship between the availability of the reference manuals that manufacturing employees have access to and the product rejects. If the workers follow the procedures as laid down in the manuals, they are able to manufacture products that are flawless. This relationship holds true generally for all workers. However, it is also dependent on the inclination/attitude of the employees to look into the manuals whenever there is a new procedure to be adopted. In other words, only those who have the interest and urge to refer to the manual every time a new process is adopted will produce flawless products. Others who do not consult the manual will continue to produce defective products. This influence of the attitudes of the workers on the relationship between the independent and the dependent variables is known as the moderating variable and is illustrated in the figure below.

 Availability of reference manual no rejects

 Independent variable Dependent variable

 Availability of reference manual no rejects

 Independent variable Dependent variable

 interest &

 inclination

 Moderating variable

Another example: A company has a diversified workforce. The effectiveness of the organisation is dependent on the ability of the manager to capitalise on this diversified workforce. The diversified workforce is the independent variable and the effectiveness of the organisation is the dependent variable. The degree of effectiveness of the organisation is influenced by the ability of the manager to use the diversity workforce. The relationships among the variables can be shown as follows:

 Workforce Organisational effectiveness

 Independent variable Dependent variable

 Managerial

 expertise

Moderating variable

*The distinction between an independent variable and a moderating variable*

* Normally an independent variable directly influences the dependent variable and the effect is shown in figure (a).
* However a moderating variable tends to modify the influence of the independent variable on the dependent variable. This can be seen in figure (b), where the expertise of the manager can change the influence of the workforce on the effectiveness of the organisation.

 Effects for those

 high in growth

 Workforce Workforce

 Effect for those

 low in growth

 Organisation effectiveness Organisation effectiveness

 Figure (a) Figure (b)

 Note the steepness of the top line and the relative flatness of the bottom line in Figure (b).

**d) Mediating variable (Intervening variable)**

* Mediating/Intervening variables are different from dependent variables or any of the types of independent variables.
* An intervening variable is an attribute or characteristic that stands between the independent variable and dependent variable and exercises an influence on the dependent variable and the independent variable.
* Intervening variables transmit (or mediate) the effects of the independent variable on the dependent variable.
* It is a variable that surfaces between the time the independent variables start operating to influence the dependent variable and the time their impact is felt on it (i.e. later).
* There is a temporal quality or time dimension to the mediating variable. In other words, bringing a mediating variable into play helps you to model a process.
* The mediating variable surfaces as a function of the independent variable(s) operating in any situation, and helps to conceptualize and explain the influence of the independent variable(s) on the dependent variable.

E.g. in the previous example, the workforce as an independent variable influences the dependent variable (organisational effectiveness), the mediating variable that surfaces as a function of the diversity in the workforce is the “creative synergy” that comes from the differences in the culture, experience and skills of the different workers in the organisation. This creative synergy surfaces at time , t2  and then helps organisation to attain organisational effectiveness subsequently in t3. This development is illustrated in the figure below.

 Time t1 t2 t3

 Workforce Creative Organisational

 diversity synergy effectiveness

 Independent variable Mediating variable Dependent variable

What can happen to the above situation if a moderating variable (managerial expertise) is included? The model is changed or the relationships of the four variables will be affected and this can be seen in the figure below.

 Time t1 t2 t3

 Workforce Creative Organisational

 diversity synergy effectiveness

 Independent variable Mediating variable Dependent variable

 Managerial

 expertise

 Moderating

 variable

It shows that the managerial expertise moderates the relationship between workforce diversity and creative synergy. In other words, the creative synergy will not result from the problem-solving skills of the diverse workers unless the manager is capable to harnessing that synergy by creatively coordinating the problem-solving skills of the different skills of the workers. If the manager does not have the expertise to perform this role, then no matter how many different problem-solving skills the diverse workforce might have, synergy will not surface. Instead of functioning effectively, the organisation might just remain static, or even become worse.

* + 1. **A concept model (a schematic diagram)**

 It is presented to describe your ideas about how the concepts (variables) are related to each

 other.

 For example:

 Independent variables mediating variable dependable variable

 Moderating

 variable

* + 1. **Theory**

 **A theory or a clear explanation** for the relationships in your model is the last component of

 the theoretical framework. From the theoretical framework, testable hypotheses are

 developed to examine whether the theory formulated is valid or not.

 *How Theory is generated*

 The literature review is an imperative activity because the literature review is the foundation

 for the development of the theoretical framework. From the theoretical framework the entire

 deductive research project is based (a quantitative approach). It is a logically developed,

 described and elaborated network of associations among the variables deemed relevant to the

 problem situation and identified through such process as interviews, observations and

 literature review (research methods/data collection instruments). Other factors like intuition

 and experience also guide the development of the theoretical framework. ***A theory is derived***

 ***from the conclusion of the relationships of the variables in the model.***

**Note** that it is through the literature review that the variables are identified by previous research findings. It is through the connections of the variables that the theoretical model is evolved. The theoretical framework represents and elaborates the nature and direction of the relationships. Just as the literature review sets the stage fo*r a good theoretical framework, this in turn provides for the development of the testable hypotheses.*

Brief summary in schematic form:

**Literature review**

 **Deductive Approach**

**Variables**

 **The Theoretical**

 **Framework Associations of variables**

**Model of associations/relationships**

**(Conceptual Model)**

**Theory**

**Testable hypotheses**

 **Testing of the hypotheses (through collection of data)**

**Outcome/result to the research problem**

* + 1. **Hypothesis Development**

Quantitative Definition and Purpose of Hypotheses

When researchers conduct studies they want to know if a specific variable they are studying will have an effect on a specific population. Since it is unpractical to test the entire population, a sample is taken from the population to test the population. Then a *statistical hypothesis* is made on the assumption of the population from the sample taken. This hypothesis testing allows the researcher to use sample data and to infer the results from the sample to the population. The purpose of the hypothesis is to decide whether the results of the study indicate a real relationship between variables, or if the results simply show the random fluctuation that would be the result of chance.

What is a hypothesis?

Hypothesis is an educated guess that a researcher makes based on information available to him. This information can be obtained from researcher’s own experience or from the literature review. The hypothesis so developed will be tested using an appropriate statistical procedure to decide it can be accepted or rejected. The researcher does not set out to prove the hypothesis but rather collect data that either support or do not support the hypothesis.

***All quantitative research studies require having hypotheses.*** However the possible exception in quantitative research studies is the descriptive study whose purpose is to answer certain specific questions.

*Hypotheses are derived from theories or from knowledge gained while reviewing the related literature*. (See theoretical framework.) Therefore it is essential to conduct a literature review in order to develop appropriate hypotheses for the related topic.

Generally *a quantitative researcher formulates a hypothesis before conducting the study because the nature of the study is determined by the hypothesis. Every aspect of the research is affected by the hypothesis, including participants, measuring instruments, design, procedures, data analysis and conclusions.*

It is imperative to understand that although all hypotheses are based on theory or previous knowledge, they aim to extend the knowledge. There are certain criteria that are applied to determine the value of a given hypothesis.

Criteria for Hypothesis

In quantitative research a good hypothesis has the following characteristics:

1. It is based on sound reasoning that is consistent with theory or previous research.
2. It provides a reasonable explanation for the predicted outcome.
3. It clearly states the expected relationship between defined variables.
4. It is testable within a reasonable time frame.

Types of Hypotheses

1. In terms of how they are derived such as *Inductive* hypothesis or *Deductive* hypothesis.

2. In terms of expected relationship or difference between two variables such as

 *non-directional* hypothesis or *directional* hypothesis.

3. In terms of significant or different relationship such as the null hypothesis.

**Stating a Hypothesis**

A good hypothesis is stated clearly and concisely, expresses the relationship between two variables and defines those variables in measurable terms.

Writing Quantitative Hypotheses

Guidelines:

1. State the variables in this order: independent (first position), dependent (second position) and control (third position).
2. If comparing groups in the hypothesis, explicitly state the groups, if variables are related, specify the relationship among the variables.
3. Make a prediction about changes you expect in your groups, such as less or more favourable or no changes (e.g. no difference). You will then test this prediction using statistical procedures.
4. You may state information about the participants and the site of the study, but this information may not be necessary if it repeats information stated in your purpose statement.

Formats regarding Statements of Hypotheses

**1. If-the statements**

 Example:

***If*** *young women are more frequently exposed to images of thin models in advertisements,*

***then*** *they will be more likely to express dissatisfaction with their body weight.*

**2. Directional and nondirectional hypotheses**

 Examples:

 Directional hypotheses:

 *The* ***greater*** *the stress experienced in the job, the* ***lower*** *the job satisfaction of employees.*

 *Women are* ***more*** *motivated* ***than*** *men.*

 Nondirectional hypotheses:

 *There is a relation between arousal-seeking tendency and consumer preferences for complex*

 *designs.*

 *There is a difference between the work ethic values of American and Asian employees.*

**3. Null and Alternate Hypotheses**

There are two types of hypotheses: the null and the alternative to the null. They are needed in a research study.

|  |  |  |
| --- | --- | --- |
| Type of hypothesis | Null Hypothesis | Alternative Hypothesis |
| Purpose | To test in the general population that there is no change, no relationship, no difference | The hypothesis that may be true if the null is rejected; it suggests a change, a relationship or a difference. |
| Specific language | There is no difference (or relationship) between. | Magnitude statements such as higher, lower, more positive, more favourable. |
| How researcher test the Hypothesis | A test of the hypothesis | A test of the hypothesis. |

*Null Hypotheses*

A null hypothesis (labelled as H0) is set up to be rejected in order to support an alternative hypothesis (labelled as HA). The null hypothesis is presumed true until statistical evidence, in the form of hypothesis testing, indicates otherwise. However, it is stated typically in terms of there being no (significant) relationship between two variables or no (significant) difference between two groups. What is this all about? Well, in setting up the null hypothesis, we are stating that there is no difference between what we might find in the population characteristics and the sample we are studying. Since we do not know the true state of affairs in the population, all we can do is to draw inferences based on what we find in our sample. What we imply through the null hypothesis is that any differences found between two sample groups or any relationships found between two variables based on our sample are simply due to random sampling fluctuations and not due to any “true” differences between the two population groups or relationships between two variables. The null hypothesis is thus formulated so that it can be tested for possible rejection. If we rejection the null hypothesis then all permissible alternate hypotheses relating to the particular relationship tested could be supported. It is the theory that allows us to have faith in the alternate hypothesis that is generated in the particular research investigation. *This is one more reason why the theoretical framework should be grounded on sound, defendable logic to start with. Otherwise, other researchers are likely to refute and postulate other defensible explanations through different alternate hypotheses.*

The null hypothesis in respect of group differences stated in the example “Women are more motivated than men” would be:

 H0: $µ$m = µw

 or

 H0: $µ$m -µw = 0

where H0 represents the Null Hypothesis, $µ$m is the mean motivational level of men and µw is the mean motivational level of the women.

The alternate for the above example would statistically be set as follows:

 HA: $µ$m $<$µw

whichis the same as

 HA: $µ$w $>$µm

where HA represents the alternate hypothesis and $µ$m andµw are the mean motivation levels of men and women respectively.

For the *nondirectional hypothesis* of mean group differences in work ethic values in the example

“There is a difference between ethic values of American and Asian employees.”

 H0: $µ$am = µas

 or

H0: $µ$am -µas = 0

where H0 represents the null hypothesis,$µ$am is the mean of work ethic value of Americans and  µas  is the mean work ethic value of Asians.

The alternate hypothesis for the above example would statistically be set as:

 HA: $µ$am ≠ µas

where HA represents the alternate hypothesis and $µ$am is the mean work ethic of the Americansand µas is the mean work ethic of Asians.

The null hypothesis for the relationship between the two variables in the example “The greater the stress experienced in the job, the lower the job satisfaction of employees,” would be H0: There is no relationship between stress experienced on the job and the job satisfaction of employees. This would be statistically expressed by:

 H0: p = 0

where p represents the correlation between stress and job satisfaction, which in this case is equal to 0 (i.e. no correlation).

The alternate hypothesis for the above null, which has been expressed directionally, can be statistically expressed as:

 H0: p < 0 (the correlation is negative)

For the example “There is a relationship between age and job satisfaction,” which has been stated nondirectionally, the null hypothesis would be statistically expressed as:

 H0: p = 0

whereas the alternate hypothesis would be expressed as

 H0: p ≠ 0

Having formulated the null and alternate hypotheses, the appropriate statistical tests (t-tests, F-tests) can then be applied, which indicate whether or not support has been found for the alternate hypothesis – i.e. that there is a significant difference between groups or that there is a significant relationship between variables as hypothesized.

The steps to follow in testing hypotheses:

State the null hypothesis, Ho and the alternate hypotheses, H1

Choose the relevant statistical test (depending on whether the data collected are parametric\* or nonparametric\*\*)

Determine the level of significance desired (p = 0.05, or more, or less)

Compute the test value

Obtain the critical value

 Is the calculated No

 test value > Do not reject Ho

 critical value?

 Yes

 Reject Ho

 \* Parametric test – data follow a normal distribution and using means and standard

 Deviations.

 \*\* Nonparametric test – not possible to have normal distribution and sample is of small size.

 Both are derived from *inferential statistics* where the data is used to infer to a wider

 population.

1. State the null and alternative hypothesis

The researcher starts the analysis usually by stating the null hypothesis (Ho) and the alternative hypothesis (H1). Before stating the hypotheses, it is always advisable to state the research problem in terms of a question that identifies the population (s) of interest to the researcher, the parameter(s) of the variable under investigation, and the hypothesised value of the parameter(s). This helps the researcher to clearly state the null and alternative hypotheses for the research problem under investigation.

For example, A lecturer has observed that the female students are generally more attentive in class than the male students. An obvious question may strike the mind: Is the performance of the female students better than the performance of male students? If this question is set for the purpose of investigation, the null and alternative hypotheses can be defined as:

Ho : There is no significant difference in the average marks scored by male and female

 students (Ho: u1 = u2)

H1: The average marks scored by female students is significantly higher than the average

 marks scored by male students (H1: u1 > u2).

1. Choose the relevant statistical test

Here the researcher has to decide what test will be used based on the values of the parameters that will be tested. This is also where the researcher will decide whether to use a parametric or a non-parametric test. A clear statement of the hypotheses helps the researcher in deciding the types of variable(s) that should be used in sample data collection which further defines statistical test to be used. For example, in the above stated hypothesis, the parametric test will be most suitable as the variable (mars) is a ration scaled variable.

1. Select the relevant level of significance

The researcher has to fix the criteria for the decision which means defining the alpha level and critical region. The critical region is composed of extreme scores that are very unlikely to be obtained if the null hypothesis is true. The result has to be beyond these scores in order to be statistically significant.

The alpha level is a probability value. It defines the critical region and tells us the probability that a result beyond the critical region occurred by chance. Normally the levels of significance used by most of the researchers are 0.01 and 0.05. A level of significance

(α = 0.05) implies that there is a 5% chance that a result in the critical region occurred by chance.

1. Compute the calculated value

Once the data is collected, the researcher’s job is to calculate the test value of the relevant statistical test.

1. Obtain the critical test value based on the test in step 2

After calculating the value based on the selected test, we have to look up the critical values for each test based on the particular distribution of the test (i.e. normal, X2, t, *F*). This critical value will help us in the decision whether the hypothesis is supported or not supported.

1. Draw the conclusion

If the calculated value is larger than the critical value then we reject the null hypothesis and conclude that the alternative hypothesis is supported.

Type I and Type II Errors

There is always a risk that the inference a researcher draws about a population may be incorrect. There are two types of errors associated with hypothesis testing. We may reject Ho when Ho is true and we may accept Ho when Ho is not true. The former is known as Type 1 error and the latter as Type II error. The Type I error is denoted by alpha (α), known as α error or the level of significance of test. Type II error is denoted by beta (β), known as β error. These two types of errors can be represented in the tabular form:

|  |  |
| --- | --- |
|  |  Decision |
| Accept Ho | Reject Ho |
| Ho (True) | Correct decision | Type I error (α error) |
| Ho (False) |  Type II error (β error) |  Correct Decision |

The probability of Type I error is usually determined in advance and is understood as the level of significance of testing the hypothesis. If Type I error is fixed at 5%, it implies that there are about 5 chances out of 100 that we will reject Ho when Ho is true. The Type I error can be controlled by fixing it at lower level. For example, instead of fixing it at 5%, if we fix it at 1%, then the probability of committing Type I error reduces from 0.05 to 0.01.

But with a fixed same size, n, when we try to reduce Type I error, the probability of committing Type II error increases.

* 1. **Qualitative Definition and Purpose of Hypotheses**

Qualitative researchers do not state formal hypotheses before conducting a study. They seek to understand the nature of their participants and contexts before stating a research focus or hypothesis. They may develop hypotheses to guide them for their proposed research but they are not tested. The qualitative researchers gather data and then build patterns and associations in the participants’ natural environment without having prior hunches of what to study or observe.

Identifying patterns and associations in the natural setting help the researchers to discover ideas and questions that lead to new hunches or hypotheses. Therefore, in qualitative research, the strength lies in generating hypotheses not testing hypotheses.

Having identified a guiding hypothesis, the qualitative researcher may “operationalize” the hypothesis through the development of research questions that provide the researcher with a focus for data collection. The qualitative research questions may encompass on topics such the participants’ understanding of meanings and social life in a particular context.