

---

# Contents

---

<b>Preface</b>	<b>xiii</b>
<b>Acknowledgement</b>	<b>xv</b>
<b>Abstract</b>	<b>xvii</b>
<b>1 What Is Research?</b>	<b>1</b>
1.1 Introduction . . . . .	1
1.2 Research and Development: What Is the Difference? . . . . .	3
1.3 Research, Development and PhD Students . . . . .	4
Tasks . . . . .	5
<b>2 Why Are We Researchers?</b>	<b>7</b>
2.1 Introduction . . . . .	7
2.2 What Is the Aim of PhD? . . . . .	9
2.3 University and Their PhD Students . . . . .	10
2.4 Causes of Stress for the Candidates . . . . .	10
2.5 Shortcomings of Output Focused PhD . . . . .	12
2.6 Managing the Short-Term Demands . . . . .	13
Tasks . . . . .	14
<b>3 Attributes of a Researcher</b>	<b>15</b>
3.1 Introduction . . . . .	15
3.2 Knowledge and Creativity . . . . .	16
3.2.1 Researcher Attribute – Knowledge . . . . .	17
3.2.1.1 Ideas vs. literature review . . . . .	17
3.2.1.2 Literature review: Attention to detail . . . . .	18
3.2.2 Researcher Attributes: Creativity . . . . .	19
3.2.2.1 Fostering creativity . . . . .	19
3.3 Research Attributes: Resilient and Self-Confident . . . . .	20
3.3.1 Supporting to Develop Self-Confidence . . . . .	22

3.4	Research Attributes: Planning and Discipline . . . . .	23
3.4.1	Time Management . . . . .	24
3.5	Researcher Attribute: Flexibility . . . . .	25
3.6	Researcher Attributes: Communication . . . . .	25
3.6.1	What Is Communication? . . . . .	26
3.6.2	Clarity of the Message . . . . .	26
3.6.3	Ability to Listen . . . . .	26
3.7	Research Attributes: Partnership and Networking . . . . .	27
3.7.1	Networking with Other Researchers . . . . .	28
3.7.2	Partnership with Industry and External Agencies . . . . .	28
	Tasks . . . . .	29

**4 The Supervisor and the Supervised 31**

4.1	Introduction . . . . .	31
4.2	Student and Supervisor . . . . .	33
4.2.1	Supervisor and the Student; Reality Check . . . . .	33
4.2.2	An Ideal Supervisor . . . . .	33
4.2.3	An Ideal Student . . . . .	34
4.2.4	The Real Situation . . . . .	35
4.2.5	The Real Supervisor . . . . .	36
4.2.5.1	The supervisor does not appear to have the time for the student or the project . . . . .	36
4.2.5.1.1	<i>Suggestions to the student</i> . . . . .	37
4.2.5.2	The supervisor appears to be unreasonable in the expectations of the student . . . . .	38
4.2.5.3	Supervisor does not appear to have the knowledge of the topic . . . . .	39
4.2.5.4	Supervisor does not appear to be interested in the student, the topic or the outcomes . . . . .	40
4.2.5.5	Supervisor makes personal remarks or invitations . . . . .	40
4.2.5.6	Romantic liaison . . . . .	41
4.2.5.7	Supervisor personality type; Lacks emotions or is too emotional . . . . .	42
4.2.5.8	Personality clash . . . . .	43
4.2.6	Real Research Student . . . . .	44
4.2.6.1	Transition from undergraduate to post-graduate . . . . .	44
4.2.6.1.1	<i>Change of expectations</i> . . . . .	45

4.3	Selection of the Supervisor and Student . . . . .	45
4.3.1	Background of Student . . . . .	46
4.4	Networking . . . . .	47
4.4.1	Networking with Other Professors . . . . .	47
4.4.2	Industry Partnership: Support for Students . . . . .	47
4.5	Dispute Management and Resolution . . . . .	48
4.5.1	Causes of Disputes . . . . .	48
4.5.1.1	Expectations . . . . .	49
4.5.1.2	Challenge of research outcomes . . . . .	49
4.5.1.3	Personal beliefs and desires . . . . .	50
4.5.2	Resolving and Managing Disputes . . . . .	50
4.6	Communication – Supervisor and the Supervised . . . . .	51
4.7	Being Mindful with Supervisor . . . . .	52
	Tasks . . . . .	53
<b>5</b>	<b>Responsibilities of a Researcher</b>	<b>55</b>
5.1	Introduction . . . . .	55
5.2	Accountability . . . . .	56
5.2.1	What Is the Need? . . . . .	56
5.2.2	Comparison between Researchers . . . . .	57
5.2.3	Challenges in Measuring Research Outcomes . . . . .	57
5.3	Measuring Research Outcome . . . . .	60
5.3.1	Some Measures of Research Impact . . . . .	61
5.4	Need for Peer Review . . . . .	62
5.5	Publications for Spread and Growth of Knowledge . . . . .	63
5.5.1	Review Process: Spread of Knowledge . . . . .	64
5.6	Review Process . . . . .	64
5.6.1	Managing the Review Process . . . . .	65
5.7	Summary of Responsibilities of Researchers . . . . .	66
	Tasks . . . . .	66
<b>6</b>	<b>Continuing to Be a Researcher: Motivation Issues for Researchers</b>	<b>67</b>
6.1	Introduction . . . . .	67
6.2	Mid-Candidature Blues . . . . .	69
6.3	Why Do We Get the Blues? . . . . .	70
6.4	Motivating a Researcher – Suggestions for the Supervisor . . . . .	72
6.4.1	Corporate Style Carrot and Stick Approach . . . . .	72
6.4.2	Accolades and Shaming . . . . .	73
6.4.3	Finding Motivation is Personal . . . . .	73

6.5	How to Motivate Yourself? . . . . .	74
6.5.1	Identifying the Different States . . . . .	76
6.5.2	Lazy and Confused State: What Happens? . . . . .	77
6.5.2.1	Lazy and confused state: What to do? . . . . .	78
6.5.3	In the Active State . . . . .	79
6.5.4	The Creative State . . . . .	81
6.5.4.1	Stating the vision . . . . .	82
6.5.4.2	Planning for the vision . . . . .	82
6.5.4.3	Short term goals . . . . .	83
6.6	How to Become Productive? . . . . .	84
	Tasks . . . . .	84
<b>7</b>	<b>Research Proposal</b>	<b>85</b>
	Task Before You Start This Chapter . . . . .	85
7.1	Introduction . . . . .	86
7.1.1	Dynamic Idleness . . . . .	86
7.1.2	Mid-Candidature Blues . . . . .	87
7.2	Purpose of Research Proposals . . . . .	88
7.3	What Is a Research Proposal? . . . . .	88
7.4	Developing the Research Proposal . . . . .	89
7.4.1	Title . . . . .	90
7.4.2	Aim . . . . .	90
7.4.3	Objective . . . . .	91
7.4.4	Scope . . . . .	91
7.4.4.1	Example to explain scope . . . . .	92
7.4.5	Research Questions . . . . .	92
7.4.5.1	Example of research proposal . . . . .	93
7.4.6	Developing the Hypothesis . . . . .	95
7.4.6.1	Example for developing the hypothesis . . . . .	95
7.4.7	Developing the Methodology . . . . .	96
7.4.8	Time Frame . . . . .	97
7.4.8.1	Project timeline . . . . .	97
7.4.8.2	Regularity in timeline . . . . .	98
7.4.8.3	Changes to the timeline . . . . .	98
7.4.9	Milestones . . . . .	99
	Tasks . . . . .	99
<b>8</b>	<b>Planning the Experiments</b>	<b>101</b>
8.1	Introduction . . . . .	101
8.2	Focus and Scope . . . . .	102

8.3	Inferential Statistics . . . . .	102
8.4	Descriptive Statistics . . . . .	102
	8.4.1 Central Tendency . . . . .	103
	8.4.2 Dispersion . . . . .	103
8.5	Significance . . . . .	103
8.6	Statistical Hypothesis . . . . .	105
8.7	Measuring Significance . . . . .	105
	8.7.1 $p$ Value to Test Null Hypothesis . . . . .	106
	8.7.2 What Is Significance Level? . . . . .	106
8.8	Reproducibility . . . . .	107
8.9	Types of Statistical Tests . . . . .	107
	8.9.1 Parametric Tests . . . . .	107
	8.9.2 Non-Parametric Tests . . . . .	108
8.10	Confidence Band, Confidence Intervals and Confidence Levels . . . . .	109
8.11	Statistical Tests . . . . .	109
	8.11.1 Correlation . . . . .	109
	8.11.2 Regression . . . . .	109
	8.11.3 t-test . . . . .	110
	8.11.3.1 Unpaired t-test . . . . .	110
	8.11.3.2 Paired t-test . . . . .	110
	8.11.4 Analysis of Variance (ANOVA) . . . . .	111
8.12	System Performance Measure . . . . .	111
	8.12.1 Accuracy, Sensitivity and Specificity . . . . .	111
	8.12.2 Confusion Matrix . . . . .	113
	8.12.3 Statistical Power . . . . .	113
	8.12.4 Receiver Operator Characteristic (ROC) Curve . . . . .	113
	Tasks . . . . .	115

**9 Communication Skills 117**

9.1	Introduction . . . . .	117
9.2	Need to Communicate for Researchers . . . . .	118
9.3	Essentials for Effective Communication . . . . .	118
9.4	Developing Oral Communication . . . . .	119
	9.4.1 Planned and Focused . . . . .	120
	9.4.2 Connect with Audience . . . . .	120
9.5	Presenting to Your Supervisors . . . . .	121
9.6	Conference Seminar . . . . .	122
	9.6.1 Example for Audience Focus . . . . .	122

9.7	Listening and Observing . . . . .	123
9.8	Planning the Presentation . . . . .	124
9.8.1	How to Start: A Brief to Put in Context . . . . .	124
9.8.1.1	Example . . . . .	125
9.8.1.2	Example . . . . .	125
9.8.2	Content . . . . .	126
9.8.3	Conclusion . . . . .	126
9.8.3.1	Facts and opinion . . . . .	127
9.9	Style of Communication . . . . .	127
9.9.1	Aggressive Communication . . . . .	128
9.9.2	Passive Communication . . . . .	128
9.9.3	Assertive Communication . . . . .	128
9.9.4	Examples: Aggressive and Assertive Communication . . . . .	129
9.10	Written Communication . . . . .	130
9.10.1	Informal Written Communication . . . . .	131
9.10.1.1	Writing emails . . . . .	132
9.11	Formal Written Communication . . . . .	134
9.11.1	Structure . . . . .	134
9.11.2	Style . . . . .	135
9.11.2.1	Compact . . . . .	135
9.11.2.2	Formal . . . . .	135
9.11.2.3	Simple statements . . . . .	136
9.11.3	Content . . . . .	136
9.12	Some Points for Effective Written Communication . . . . .	137
	Tasks . . . . .	138
<b>10</b>	<b>Why Publish? . . . . .</b>	<b>139</b>
10.1	Introduction . . . . .	139
10.2	Peer Review of Research . . . . .	140
10.3	Publications for Accountability . . . . .	141
10.4	Manuscript Submissions as Milestones . . . . .	142
10.5	Publications for Employability . . . . .	143
10.6	How to Stand Out of the Crowd? . . . . .	144
10.7	Benefit to the Society . . . . .	145
10.8	Measure of Outcomes . . . . .	146
10.9	Getting the Balance . . . . .	147
	Tasks . . . . .	148

<b>11 How to Publish: Writing Manuscripts</b>	<b>149</b>
11.1 Introduction . . . . .	149
11.2 Target Audience . . . . .	150
11.3 When to Start the Manuscript? . . . . .	151
11.4 Develop a Plan . . . . .	152
11.5 Typical Subheadings of a Paper in Science, Engineering and Health . . . . .	152
11.6 Starting the Manuscript . . . . .	153
11.7 The Title . . . . .	154
11.8 Abstract . . . . .	154
11.9 Writing the Introduction . . . . .	155
11.9.1 Introduction – Some Common Mistakes . . . . .	156
11.10 Theory . . . . .	157
11.11 Methodology . . . . .	158
11.12 Data Analysis . . . . .	159
11.13 Discussion . . . . .	159
11.14 Conclusion . . . . .	160
11.15 Paper Iterations . . . . .	160
11.16 List of Authors . . . . .	161
11.17 What Gets Published? . . . . .	161
11.18 What Gets Rejected? . . . . .	163
11.19 Post-Submission of Manuscript . . . . .	163
11.20 Difference between Thesis and Manuscript . . . . .	164
11.21 Review Process . . . . .	165
11.22 Managing the Review Process . . . . .	167
Tasks . . . . .	168
 <b>Appendix</b>	 <b>169</b>
 <b>Index</b>	 <b>171</b>
 <b>About the Author</b>	 <b>173</b>