Using a Statistical Method to Compare Agile and Waterfall Processes Performance

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Agenda

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- **Introduction**
- **Research Method**
- **Research Development**
- **Results Analysis**
- **Conclusion**

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Introduction

- The agile methods and good-practices have been employed by several organizations to support their software development processes.

- A previous experience report described a parallel development approach that employed a spare team of developers to initiate the agile transition in a telecommunication services company.

Introduction

- However, the results analysis was not performed using any consistent method.
- This time, a set of ten projects were developed and the results analysis was performed with the Wilcoxon signed-rank test.

Introduction

- The Wilcoxon signed-rank test is a nonparametric statistical method whose application is suitable to perform data analysis from two-paired groups with different conditions.

- The “W” test allows researchers to calculate and analyze the difference between the paired samples.

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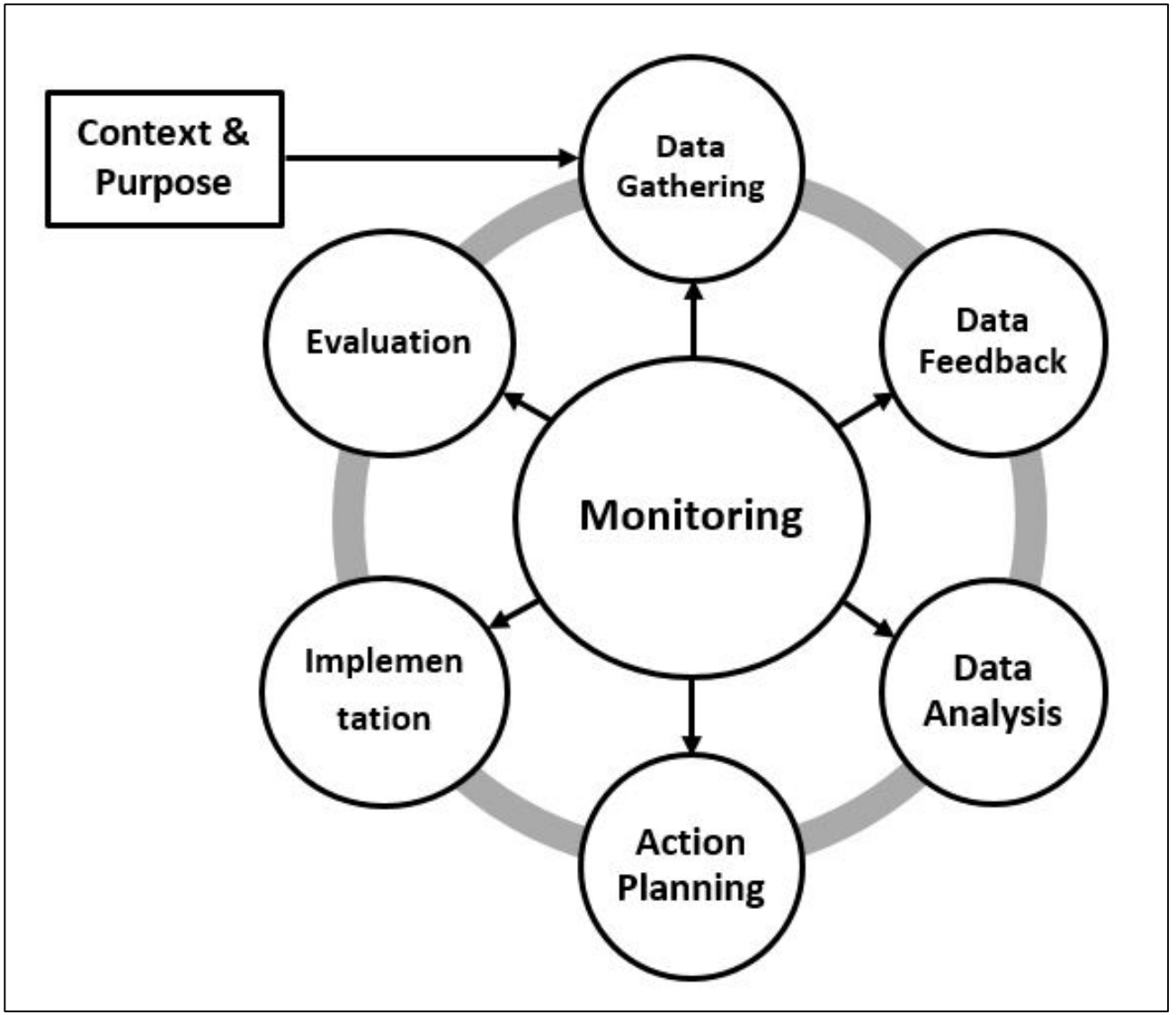
Research Method

- The reported experience took place within a telecommunication company in Brazil.
- A research group was composed by an external researcher and two employees (company's internal process specialists).
- In this case, the suitable research method was the Action-Research.

Research Method



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Research Development

- The initial analysis was focused on the necessary effort (hours) to deliver the project using both software development processes.

- The agile process spent more hours than the waterfall. It was necessary to check if this difference in effort is statistically significant.
  - **Hypotheses 1**: The agile process is more expensive than the waterfall based one.
  - **Hypotheses 2**: The agile process performance is not significant different from the waterfall based one.

Research Development

Wilcoxon Signed-Ranking Test - Analyzing Projects Effort (Hours)						
Project	Waterfall	Agile	Difference	Rank	Rank Sum	
01	112	128	16	(2) 3	Positive	37
02	600	680	80	8	Negative	18
03	836	960	124	9		❸
04	708	672	-36	7		
05	400	560	160	10	Values	
06	228	244	16	(3) 3	W	18 ❹
07	488	456	-32	6	N	10 ❺
08	272	288	16	(4) 3	α < 0.05	8 ❻
09	240	252	12	1		
10	672	648	-24	5		
Average	455,6	488,8	❶	❷		

Hypotheses 2: The agile process performance is not significant different from the waterfall based one.

Research Development

- Checking the processes' average number of defects, the waterfall process produced more defects during the integration test.
- The Wilcoxon test regarding the number of defects identified in the processes considered the following hypotheses:
  - **Hypotheses 1**: The waterfall process produces more defects than the agile one.
  - **Hypotheses 2**: The number of defects produced by the waterfall process is not significant different from the agile one.

Research Development

Wilcoxon Signed-Ranking Test - Analyzing Projects Defects						
Project	Waterfall	Agile	Difference	Rank	Rank Sum	
01	16	4	-12	6	Positive	0
02	8	0	-8	(3) 3,5	Negative	55
03	16	2	-14	(7) 7,5		❸
04	19	5	-14	(8) 7,5		
05	8	3	-5	1	Values	
06	13	6	-7	2	W	0 ❹
07	13	5	-8	(4) 3,5	N	10 ❺
08	19	3	-16	10	α < 0.05	8 ❻
09	12	3	-9	5		
10	19	4	-15	9		
Average	14,3	3,5	❶	❷		

Hypotheses 1: The waterfall process produced more defects than the agile one.

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Results Analysis

- Considering the “W“ tests results, it is possible to affirm that:
  - The agile process consumed more hours, due the use of practices such as TDD and PP.
  - The extra effort resulted in less software defects.
  - The PP supported the share knowledge among the team members due to its collaborative and interactive approach.

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Conclusion

- Instead of performing a simple analysis on the obtained averages values, the test identified if there was a statistically significant difference between the measured values.

- In this case, the Wilcoxon signed-rank test become an important contribution to compare process's performance indicators.

Questions???

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