A STEEPLED Analysis of the SPI Manifesto

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Abstract. Software Process Improvement (SPI) has been founded on the belief
that a well-defined and executed process is likely to produce a high-quality pro-
duct. Improving a product might provide insights for future improvement efforts.
However, this bottom-up approach does not necessarily lead to improvement,
considering in particular that software products/artefacts are usually, unique. In
contrast, an improved process is a top-down approach, which is applicable to all
products (outputs and outcomes). The SPI Manifesto places people, business
focus, and organisational change at the core of Software Process Improvement
practices. In so doing, certain SPI principles guide the behaviour of individuals,
groups, and organisations in their efforts to improve process. The SPI principles
form the basis for elaborating on certain values and serve as a foundation for
action in software development. In this paper the authors carry out a STEEPLED
[Sociocultural, Technical, Economic, Environmental, Political, Legal, Ethical
and Demographic] analysis of the SPI Manifesto. STEEPLED is a multidi-
mensional and multi-faceted analysis tool which assists in identifying the
strengths, gaps and impact of the SPI Manifesto. Future work for the SPI
Manifesto aims at (i) proposing enhancement modifications to its values and
principles and (ii) enriching the SPI Manifesto with the addition of a compara-
tive and practical philosophy level.

Keywords: SPI Manifesto · Principles · Values · Agile development ·
Change management · Software Process Improvement · STEEPLED Analysis

1 Introduction

1.1 Manifestos and Their Purpose

The Oxford English Dictionary defines a manifesto as "a public declaration of policy
and aims, especially as issued before an election by a political party, candidate, gov-
ernment, etc." [1].

Manifestos are programmatic promises of why the current situation needs to change and/or what changes are necessary for improvement. Change can be realised in the form of gradual evolution or can be radical and revolutionary. Both means have their supporters and opponents. However, manifestos rarely provide concrete guidance as to how these changes or reforms can be brought about and even less guidance is available as to how any real changes and improvements can be measured in the short or in the long run.

Many manifestos are short-lived and certainly only focus on a specific area of interest and, hence, are not universal; the narrower their scope, the more parochial their implementation and impact will be. One notable exception is the Communist Manifesto, launched in 1848 by Marx and Engels [2], that stood the test of time and is the second most read text in the world. Wood [2] stated that: … the particular manifesto was judged, among other contexts, in the context of history, culture, and politics rather than a unique influential statement in the theory and practice of revolutionary movements.

1.2   Manifestos in Software Engineering: Evolutionary or Revolutionary?

Two manifestos were issued by groups of Software Engineers (academics and practitioners in both cases), namely the Agile Manifesto [3] and the Software Process Improvement (SPI) Manifesto [4], both of which aimed to improve the software produced, through improving the process, the attitudes of software engineers, and also the organisational culture and practices.

The two manifestos and their associated methodological paradigms have been compared and contrasted [5] and criticised or praised regarding their different strengths and essential quality features of the mature software process [7, 8]. There have also been efforts to combine these two paradigms' principles and values in research and development projects focusing for instance on different aspects such as formality and agility [9, 10] and software quality deployment with scaled agility-in-the-large [10]. Hence, our motivation has been to contribute and further reflect on this analysis with reference to some recent systematic reviews and proposed developments [11–14]. The rest of the paper focuses on the SPI Manifesto, and carries out a STEEPLED (Sociocultural, Technical, Economic, Environmental, Political, Legal, Ethical and Demographic) analysis of its Values and Principles. This analysis aims to contribute to the current debate on revisiting, reviewing and updating the SPI Manifesto.

2   Software Process Improvement (SPI)

2.1   The Birth and Evolution of the EuroSPI Conference

The first EuroSPI conference was held in Dublin in 1993. EuroSPI is currently the *main* networking forum continually providing for an exchange of SPI knowledge and experience between industry and research in Europe and internationally. It aims to assure SPI implementation, basing SPI work on real practice. It has primarily formed a Europe-wide agenda and movement, with partners from across the world. *"From each*

conference, ideas were created, and a pool of experiences has been set up and made available in an online library" Messnarz et al. [13].

During the last 25 years following the launch of the Annual EuroSPI Conference, the Software Process Improvement Conference evolved to include: Innovation into System, Software Process Improvement and Innovation to System, Software, Services, Process and Product Improvement and Innovation, then Safety, Security, and Infrastructure were included [14].

Therefore, the most recent interpretations of the SPI terms stand for: System, Software, Services, Safety, and Security Process and Product Improvement, Innovation, and Infrastructure. Thus, SPI has been evolved to $S^3P^2I^3$ reflecting the evolving and maturing practices, and application research in the Software Engineering domains.

In this paper we present a theoretical analysis of the SPI Manifesto providing a framework based on the identification of the STEEPLED dimensions and their respective internal and external factors. We illustrate by applying the STEEPLED Analysis to a case study and propose some initial extensions to the SPI Manifesto.

2.2   The Articulation of the SPI Manifesto

The SPI Manifesto was launched by twenty-nine (29) Software Process Improvement experts [5] from industry and academia during the 2009 EuroSPI conference in Alcala, Spain, and was first published in 2010[1].

The SPI Manifesto encompasses three Values, namely: People (SPI must involve people actively and affect their daily activities), Business (SPI is what you do to make business successful), and Change (SPI is inherently linked with change).

These Values are elaborated and supported by the ten Principles listed below (Table 1):

Table 1. The SPI Manifesto

SPI Manifesto Principles
1 Know the culture and focus on needs
2 Motivate all people involved
3 Base improvement on experience and measurements
4 Create a learning organisation
5 Support the organisation's vision and objectives
6 Use dynamic and adaptable models as needed
7 Apply risk management
8 Manage the organisational change in your improvement effort
9 Ensure all parties understand and agree on process
10 Do not lose focus

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[1] (http://www.iscn.com/Images/SPI_Manifesto_A.1.2.2010.pdf).

In an attempt to establish whether there are any gaps or overlaps, we represent the current architecture (the three Values and ten Principles of the SPI Manifesto) in Table 2 which shows that each of the ten principles maps to one specific Value.

Table 2. Current structure of the SPI Manifesto

Principles	Values		
	People	Business	Change
1. Know the culture and focus on needs	X		
2. Motivate all people involved	X		
3. Base improvement on experience and measurements	X		
4. Create a learning organisation	X		
5. Support the organisation's vision and business objectives		X	
6. Use dynamic and adaptable models as needed		X	
7. Apply risk management		X	
8. Manage the organisational change in your improvement effort			X
9. Ensure all parties understand and agree on process			X
10. Do not lose focus			X

However, such segregation is misleading. For example: Principle 8 *Manage the organisational change in your improvement effort*, for example, involves all three Values namely People, Business, and Change. Also, Principle 1 supports the People Value, Principle 4 supports/refers to the People Value. It is evident that this Principle also involves the Business Value and the Change Value.

In Sect. 3 of the paper we are carrying out a STEEPLED Analysis in order to identify the multifaceted interconnections. This analysis contributes to the on-going effort of the Software Engineering community to improve the quality of the software development process and the quality of software products and services. Additionally this study contributes to the current debate and effort of the SPI experts to review and revise the SPI Manifesto.

3 STEEPLED: A Multidimensional Analysis

3.1 From PEST to STEEPLED Analysis

PEST is an acronym, which stands for Political, Economic, Social and Technological that are the dimensions or factors that need to be understood particularly in Strategic Management and Marketing [15, 16]. PEST is a framework of macro-environmental factors used in the environmental scanning component of strategic management.

Over the years the PEST framework and analysis evolved into PESTLE by the addition of the Legal and Environmental dimensions. The most recent format of the framework is STEEPLED, which includes the Ethical and Demographic dimensions.

The STEEPLED Analysis aims to help organisations to understand the political situation of the country or countries in which the organisations are operating. Political upheaval and instability affect the industry, including the software industry, at large.

The Technical dimension and the fast rate of change present many challenges such as expanding automation, securing upgrades, training, outsourcing and for large companies in particular, exploiting innovation and Research and Development.

The Economic dimension affects the degree to which companies will expand or contract, embark on acquisitions or mergers, invest in new infrastructure, hire and train staff and the list can go on.

The Environmental dimension of an organization is important, particularly considering issues such as global warming, and ergonomics within the organisation.

Awareness of the Social and Cultural dimensions in the era of globalisation is an important factor affecting the software development industry. Multicultural teams within the same or different organisations and across different countries is another important factor [17, 18].

Legal safeguards for the organisation, the customer, and the employees are definitely desirable, and even necessary. However, even when companies are operating within the law they may embark on unethical practices [19]; thus, the existence of the Ethical dimension could comfort the zone of scepticism and possibly provide a solution to unresolved ethical dilemmas. Finally Demographics need to be understood because local and international instability, immigration, emigration, brain drain etc. can affect organisations and whole countries particularly with loss of tacit knowledge from organisations and lack or shortage of suitable technical skills.

3.2 Complexity and Multidimensionality of Software Systems and the Software Process

Systems and Processes do not exist in a vacuum. Software artefacts, even small programs, are among the most complex objects that humans produce. Software development projects are among our most complex undertakings. Computer-based systems and information systems play a very central role in organizations while the demands on quality software-based information systems are continuously increasing. At the same time, as information systems become more complex more and people of various backgrounds, values, cultures and beliefs are involved within software development teams, continuous software process improvement has become necessary.

A multiplicity of interacting and often conflicting factors can cause problems and failures. In order to improve the software process and, hence, the software service and product, it is necessary to understand the environment (especially the Internal factors and organizational structure and their influences on the quality of software-based products and services.

4 STEEPLED: Dimensions, External and Internal Factors

4.1 External and Internal Factors

Each of the eight (8) STEEPLED dimensions consists of both external and internal factors. The external factors are known and relevant to the whole industry (e.g. competitors, governmental policies …) at national and international level while the internal factors are directly involved with the internal ways of working, practices, and regulations.

Table 3 shows the main factors relevant to each dimension.

Nowadays, almost all human activity is supported by IT systems that are affected in multiple ways by internal and external factors. Understanding their systemic and dynamic nature can greatly improve their quality. There are various thinking tools to do so, and the STEEPLED analysis technique can be one of them.

Applying, for instance, the STEEPLED Analysis we can show the multidimensional impact and ripple effect of Brexit in whatever form it may take and its implications for the British and European IT industry.

According to Beany et al. [20] there will be ramifications to the sector in the light of Brexit, not least given the uncertainty in UK politics, markets and as to the UK's future with the EU. Admittedly, the UK has a strong track record in the technology and innovation with incentives, investments and funding, while research and development are high on the agenda.

In 2018, the Norton Rose Fulbright report [21] enumerated various examples on how the technology and innovation sector might be affected when/if the UK exits the European Union, concluding that the impact upon the technology and innovation sector largely depends upon what model the UK adopts for its relationship with the EU.

Such fundamental changes as the separation of one country from a union of countries requires changes not only to policies and regulations but importantly also to the networks of communications, databases, and information systems. For instance, sharing (or not) of some security information is likely to result in poorer response to possible terrorist attacks.

Reporting on a members survey results in its Winter 2016 article "Keeping UK IT Great", the British Computer Society magazine ITNOW (p. 44) ranked as first that the most important fact needed communicating to MPs was "ensuring the UK remains a leading nation for digital innovation" In the same article it is stated that key to the trading relationship will be ensuring that the UK's legal environment is recognized as providing 'adequate protection' under the European Union's data protection law (p. 45).

The prevailing sense of uncertainty in the case of Brexit and other confusing cases could be elucidated and clarified, by suitable and multidimensional analysis tools. We show that using the SPI Manifesto Principles can help improve the way systems can be re-designed, implemented and maintained regarding not only technological robustness but also socio-economic, legal, political, ethical and environmental readiness.

Table 3. STEEPLED dimensions, external and internal factors

Dimension	External factors (national & international)	Internal (organisational) factors
Socio-Cultural (S)	Population growth, demographics, age distribution, career attitudes, power distance, norms, globalisation	Empowerment, career progression, bias & unconscious bias, experience, skills, knowledge sharing, multicultural teams, Social Responsibility
Technical (T)	Automation, rate of change, upgrades, outsourcing, R&D, innovation	Knowhow, skills, types of projects (size, complexity), experience, training, equipment, development methods, lack of skills (millennium bug)
Economic (E)	Economic growth, interest rates, inflation, living standards and income level, competition	Resources, salaries, purchases, income, policy on overtime
Environmental (En)	Climate change, ecology	Ergonomics, health and safety
Political (P)	Labour law, trade restrictions, sanctions, impact on health & safety, impact on education, unemployment	Organisational structure (power distance), rivalries, nepotism, shortage of staff
Legal (L)	Regulations, Laws: employment, consumer, health and safety, discrimination	Intellectual property, commercial confidentiality (non-disclosure agreements), whistleblowing
Ethical (Et)	Ethical rules, moral rights, Codes of conduct, Health and safety, Social Responsibility	Internal adherence to ethical rules, codes of conduct, training, awareness, Social Responsibility, Wellbeing
Demographic (D)	International upheaval (wars, national disasters, movement of people (immigration/emigration, brain drain)	Loss of organisational tacit knowledge, shortage of technical skills

It can be seen from Table 3 that all factors are interconnected and any changes (or lack of required changes) are likely to affect the process and quality of systems'.

Below we can consider "Brexit" as an example and the potential ripple effect of such a fundamental change across society and organisations as well as individuals in all dimensions.

Brexit is most obviously a socio-economic and political event, but its ramifications are enormous, clearly impacting all the other dimensions of the human activity, IT and Society at large:

Political Dimension: depending on the type of Brexit it is possible that trade restrictions will affect both the UK and the EU. At the same time unemployment may rise and companies may face shortage of suitably qualified staff.

Economic Dimension: living standards and income levels may be affected.
Environmental Dimension: could be affected by departure from the EU common regulatory framework, and also workers' rights regarding health and safety.
Sociocultural Dimension: Demographics and multicultural teams will be affected.
Technical Dimension: Research and Development (R&D) funding, imports/exports of equipment.
Legal Dimension: Uncertainties and conflicts arising from differences in regulations and laws.
Ethical Dimension: The UK has been threatening to leave the European Convention on Human Rights, which is likely to affect its ethical standards.
Demographic Dimension: The decrease/increase of population based on standard Travel/Visa Regulations will have a high impact on IT and other workforce, which could be detrimental to the work quality and software quality management. Less socio-cultural awareness due to minimized exposure to other cultures, values and norms could result in a number of conflicts and projects failures.

4.2   STEEPLED Analysis: Dimensions and Interconnections

Having identified the major external and internal factors for all eight dimensions we carried out a STEEPLED analysis, which shows that there are many more interconnections between the three Values and the ten Principles of the SPI Manifesto.

In contrast to Table 2, which associates each principle to only one of the three Values, Table 4 shows these interconnections.

For example, the Sociocultural Dimension is involved in all three Values and eight Principles. Similarly, the Ethical Dimension involves all three Values and eight Principles (not the same eight) highlighted in Table 4.

The 10 principles of the SPI Manifesto need to be imbued with ethical duties and rights. For example, in order to "Create a learning organization", the fourth SPI principle, it is imperative that those held responsible for the fulfilment of this, do so in a manner where they respect the duties and rights of all stakeholders and participants.

The ethical duties and responsibilities for SPI professionals can be sourced from traditional ethical theories. Kallman and Grillo [22] formulated a framework, which presents ethical normative principles that are sourced from traditional Deontological and Theological theories. The former enumerates a number of ethical duties and fundamental rights that all moral agents should attempt to uphold regardless of the consequential outcomes; the latter suggests three schools of thought that can be used to measure the outcomes of actions.

Spinello [23] reminds us that the relationship between law and ethics is an intimate one, where more often (than not) what the law demands from us chimes with what our ethical duties and rights are. However, there are instances where the relationship between law and ethics breaks down and there are unjust laws that provide no moral guidance. Hence, in a STEEPLED analysis for SPI the values and principles do not only adhere to legal rights and duties but also to ethical responsibilities and entitlements.

Table 4. STEEPLED analysis of the SPI Manifesto

Principles	Values		
	People	Business	Change
	Must involve people actively and affect their daily activities	Make business successful	Is inherently linked with change
1 Know the culture and focus on needs	Sociocultural [S] Ethical [Et] Demographic [D]	Political [P] Economic [E] Sociocultural [S] Demographic [D]	Ethical [Et]
2 Motivate all people involved	Sociocultural [S] Ethical [Et] Environmental [En] Economic [E] Demographic [D]	Economic [E] Demographic [D]	Sociocultural [S] Ethical [Et]
3 Base improvement on experience and measurements	Economic [E] Political [P] Sociocultural [S] Demographic [D]	Economic [E] Demographic [D]	Technical [T] Economic [E]
4 Create a learning organisation	Sociocultural [S] Ethical [Et] Economic [E] Technical [T] Demographic [D]	Economic [E] Sociocultural [S] Demographic [D]	Sociocultural [S] Demographic [D] Technical [T]
5 Support the organisation's vision and objectives	Ethical [Et] Sociocultural [S] Demographic [D]	Political [P] Economic [E] Demographic [D]	Sociocultural [S] Political [P]
6 Use dynamic and adaptable models as needed	Technical [T] Economic [E]	Technical [T] Environmental [En]	Technical [T] Environmental [En]
7 Apply risk management	Economic [E] Legal [L] Ethical [Et]	Technical [T] Political [P] Ethical [Et] Legal [L]	Technical [T] Political [P] Ethical [Et] Legal [L]
8 Manage the organisational change in your improvement effort	Ethical [Et] Demographic [D]	Technical [T] Economic [E] Demographic [D]	Political [P] Sociocultural [S] Ethical [Et] Environmental [En] Legal [L] Economic [E]
9 Ensure all parties understand and agree on process	Demographic [D] Sociocultural [S] Ethical [Et]	Demographic [D] Political [P] Sociocultural [S] Ethical [Et]	Political [P] Sociocultural [S] Ethical [Et] Environmental [En] Legal [L] Economic [E]
10 Do not lose focus	Demographic [D] Legal [L] Ethical [E]	Demographic [D] Legal [L] Ethical [Et]	Political [P] Ethical [E] Sociocultural [S]

4.3 Process Quality - A Managerial View of the SPI Manifesto

In 2017 Bresk and Scweigert [24] showed a new view on SPI given from the perspective of organisational research. It was argued that in order to understand Process Improvement it was imperative to look at the core discipline of which process improvement was a part of: The Theory of Organisations. Marvin Weisbond was identified as one influencer, whose paradigm helped define the evolvement of organisation and the empowerment of people [25]. Their analysis shows how the Agile and SPI Manifestos fit into trends of organisational change management. The particular analysis also provides a very simple understanding of process quality, summarised herein: There is need for SPI management skills and a consensus that there should be formal SPI related roles in SPI projects. A formal education of SPI managers is needed to make sure that there is a lead to success and not to frustration.

4.4 Proposal for Extending the SPI Manifesto

In Georgiadou et al. [5] we considered the Ethical and Legal Dimensions and proposed the inclusion of two additional principles namely Principle 11 – Fulfill Ethical Duties and Principle 12 – Comply with Legislation. These are shown in Table 5 (which is adapted and extended from [6] to indicate involvement in addition to influence of each Value and Principle.

Table 5. Extended list of principles and values

Principles	Values			
	People	Business	Change	Society
1. Know the culture and focus on needs	X	I	I	X
2. Motivate all people involved	X	I	I	X
3. Base improvement on experience and measurements	X	I	I	I
4. Create a learning Organisation	X	I	I	I
5. Support the Organisation's vision and business objectives	I	X	I	I
6. Use dynamic and adaptable models as needed		X	I	
7. Apply risk management	I	X	I	I
8. Manage the Organisational change in your improvement effort	I	I	X	I
9. Ensure all parties understand and agree on process	I	I	X	I
10. Do not lose focus		I	X	
11. To Fulfil Ethical Duties	**X, I**	**X, I**	**X, I**	**X, I**
12. Comply with Legislation	**X, I**	**X, I**	**X, I**	**X, I**

Key: X = involves respective Principle
I = influence respective Value

5   Conclusions and Further Work

A manifesto is a public pledge, a promise, a programme for change and, thus, it is binding. Manifestos are based on the fundamental worldviews, values and principles of the issuer(s) who can be political parties, domain specialists, groups, and even individuals within a specific historical and socio-economic context. This is the reason that political parties can be held to account if they do not deliver the promises stated in their pre-election manifestos.

As noted, manifestos tend to have a narrow scope and are short-lived. Manifestos that have universal application and appeal (like the Communist Manifesto) stand the test of time. For instance, the enduring part of the Agile Manifesto lies, apparently, in its values, rather than the principles (which are more about "how" to work). Notwithstanding, the Agile Manifesto principles are close enough to the SPI Manifesto Principles.

The evolution of the EuroSPI conference as a forum for sharing experiences, innovations and research ideas produced shared experience and collective knowledge that have been crystallized in the SPI Manifesto whose enduring characteristic is its ability to adapt to change.

As we reach a decade from the SPI Manifesto's creation, there is a professional motivation and engagement in an on-going debate and effort to review and revise the manifesto. This paper is part of this effort.

In this paper the authors carried out a STEEPLED [Sociocultural, Technical, Economic, Environmental, Political, Legal, Ethical and Demographic] analysis of the SPI Manifesto. STEEPLED is a multidimensional and multi-faceted analysis technique, which can be used as a thinking instrument in a number of cases in order to elucidate and formalise uncertain points of reference.

Ongoing and future work is being planned to start with a validation by practitioners and academics of the resulted analysis presented herein. Subsequently, a more rigorous and richer analysis of the SPI Manifesto will be conducted as part of the current review efforts. Further work for the SPI Manifesto aims at criticising and reflecting upon the usage of SPI Manifesto and SPI awareness in general, in academia and industry. A further target is to enrich the SPI Manifesto with the addition of a *comparative and practical philosophy* level proposing suitable modifications to the principles, for enhancing communication and collaboration channels academics and between academics and practitioners.

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