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# **Multidimensionality in Software Performance Measurement: the QEST/LIME models**

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# Agenda

- Introduction
- Multidimensional perspective measurement
- How Geometry helps in representing complex realities
- The QEST/LIME Models:
  - from past to future
  - application boundaries
- Conclusions & Next Steps

# Introduction

**Trend:** increased awareness of the need of process and product performance measurement

**Conventional approaches:**

- economic-financial (accounting system)
- Earned Value (cost vs. time)

**Problem:** oversimplification of the multidimensional nature of performance

**Suggestion:** take into account distinct viewpoints simultaneously (with *tangible* and *intangible* assets) as in Performance Measurement frameworks (I.e.: Balanced Scorecard, Intangible Asset Monitor, Skandia Navigator)

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# Multidimensional Perspective Measurement

For a more comprehensive view of Performance, there is a need to take into account multiple and distinct viewpoints:

<b>Actors</b>	<b>Viewpoint</b>	<b>Objectives</b>
<b>Managers</b>	<b>Economic (E)</b>	<b>Overall quality</b>
<b>Users</b>	<b>Social (S)</b>	<b>Usability</b>
<b>Developers</b>	<b>Technical (T)</b>	<b>Conformance to requirements</b>

Such as in ISO/IEC 9126 and 14598, covering the most relevant stakeholders' categories involved in a software project

# Agenda

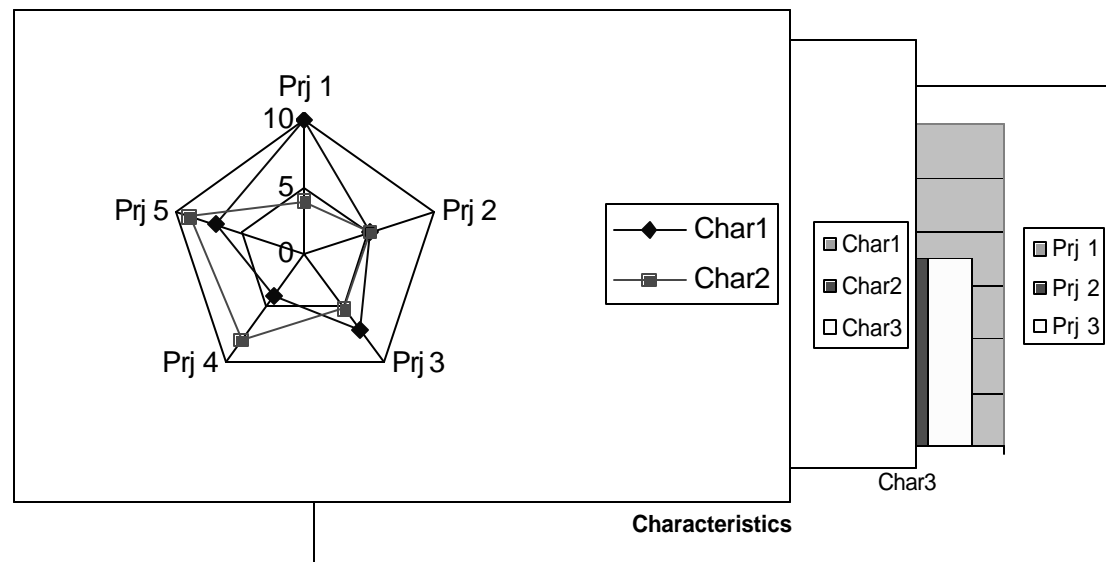
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# Geometry and complex realities representation

**Trend:** analysis of huge amount of data, usually summarised into the so-called *dashboards*

## Conventional representation 2D styles:

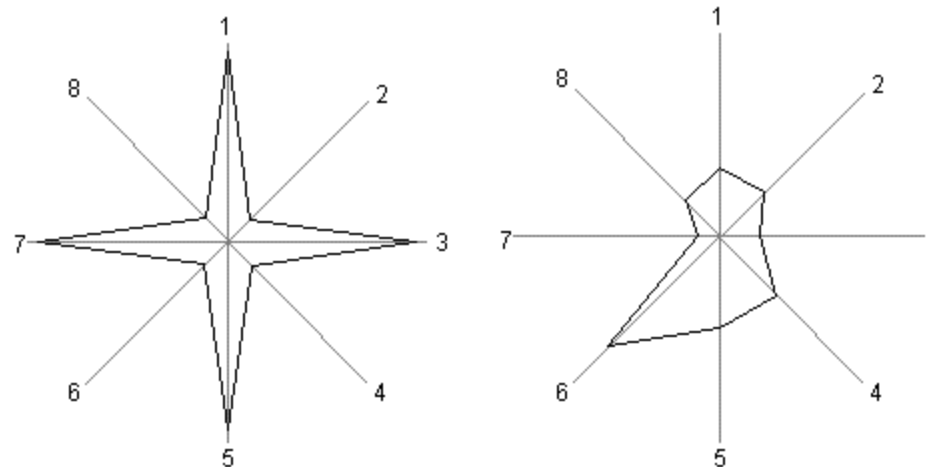
- pie chart
- histograms
- Kiviati Graph



# Kiviat Graphs

**Origin:** Introduced in 1973 for evaluating the performance of computer systems.

**Logic:** a semi-axis for each variable to measure must be drawn, tracing both boundary and current values. The final value is expressed by the Area of the derived shaped (*polygon*).





# Kiviat Graphs and similar 2D styles

**Problem:** the information associated to that representation style is over-compressed, with something that is missing.

**Example:** ancient Egyptian paintings, where the source 3D image was drawn missing its *depth*.

**Derived principle:** A correspondent relationship between the number of elements to be represented and the dimension in which the representation format is expressed must exist



# Software Performance Measurement: Some Multidimensional attempts

**(Gonzales): Vectorial approach** using *time, length* and *level* as the 3D to measure software complexity

**But** : complexity factors predefined and not normalised

**(Hatfield): Cube** using *asset / customer-project / strategic management dimensions* to measure product performance

**But**: a single not normalised measure per dimension

**(Donaldson & Siegel): Kiviat Graphs** using *n* normalised indicators to measure the product integrity value

**But**: 2D representation against a *nD* concept

# Software Performance Measurement: Some Multidimensional attempts

## Conclusion:

- each approach is of interest, but none fully addresses the simultaneity of the multidimensional representation of performance
- creation of a new approach able to overcome the problems affecting the current methods
- our proposal has been named QEST/LIME: these models use well-known concepts from Geometry to give back useful info to the Project Manager about the current status of the project and the way to improve best practices, the failing or improvable processes and the related outcomes.

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# The QEST model

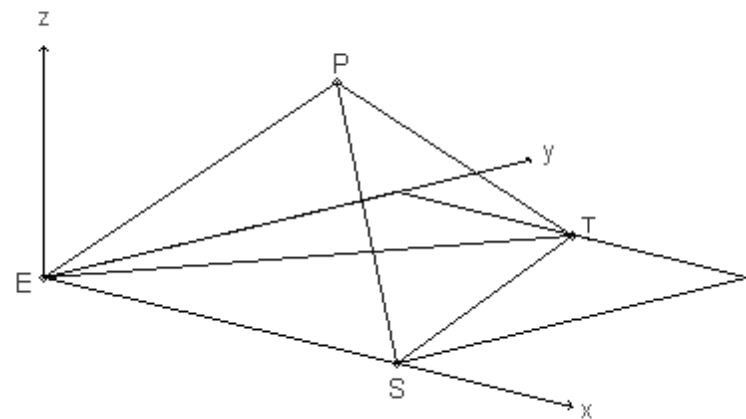
- **Method:** Performance is expressed as the combination of the specific ratios selected for each of the three dimensions of the *quantitative assessment* (Productivity - **PR**) and the **perceived product quality level** of the *qualitative assessment* (Quality - **Q**)

$$\text{Performance} = \text{PR} + \text{Q}$$

# The QEST model

- **Model:** QEST (Quality factor + Economic, Social & Technical dimensions) is a “structured shell” to be filled according to management objectives in relation to a specific project.

Such a model has the ability to handle independent sets of dimensions without predefined ratios and weights - referred to as an *open model*



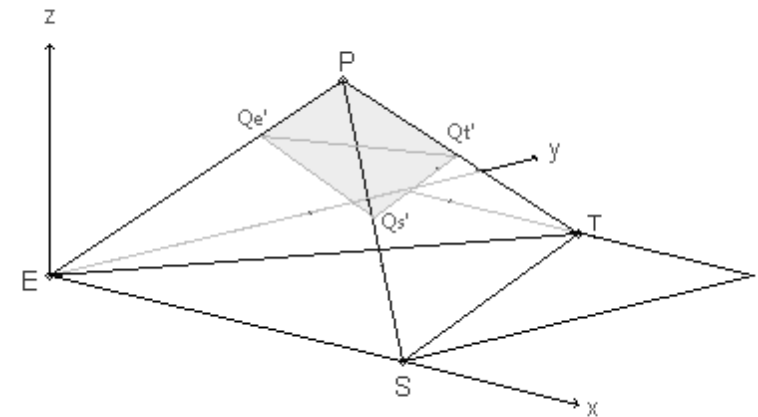
# The QEST model

- **Target:** measuring project performance ( $p$ ) using the three distinct viewpoints
- **Input Data:** list of weighted ratios for each dimension and quality questionnaires
- **Output Data:** an integrated normalized value of performance

# The QEST model - Geometrical indicators

It is possible to measure performance considering at least three distinct geometrical concepts:

- ◆ the **distance** between the tetrahedron base center of gravity and the center of the plane section along the tetrahedron height – the greater the distance from zero, the higher the performance level;
- ◆ the **area** of the sloped plane section – the smaller the area, the higher the performance level;
- ◆ the **volume** of the lowest part of the truncated tetrahedron – the greater the volume, the higher the performance level.





# The QEST Model

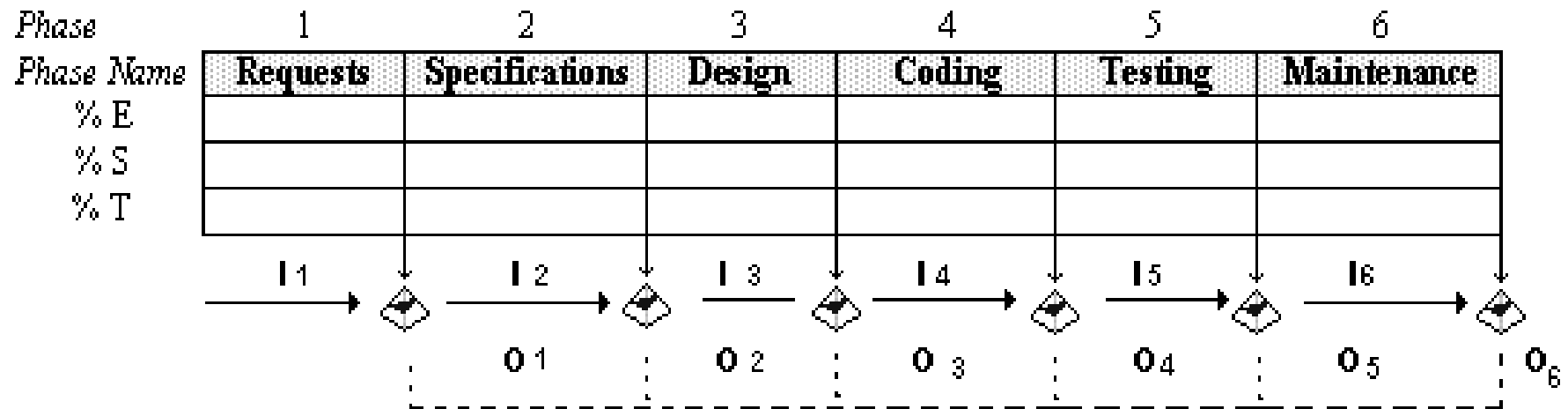
Key features are:

- **Integrated quantitative and qualitative evaluation from three concurrent organisational viewpoints**
- **Use of *de facto* and *de jure* standards**
- **a 3D geometrical representation at a single project phase (usually after the project is completed)**

# The LIME Model

**LIME** (**L**ifecycle **M**Easurement) model represents the extension of QEST features to a dynamic context as the SLC is.

**SLC model selected:** generic 6-steps Waterfall model



# The LIME Model

Key features are:

- ❶ Flexibility of distinct relative contributions from the three dimensions (E, S, T) in each phase
- ❷ Flexibility of distinct relative contributions of evaluation sources in each phase
- ❸ Flexibility in selecting measures and ratios suitable for each SLC phase



# ¿ Question ?

...and what about the case the dimensions (*stakeholders*, i.e. in the EFQM Results part of the Excellence Model they are four) to take into account will be more than **three**?

# QEST nD

**Solution:** QEST nD, through the *simplex* as the mechanism to solve the problem from the fourth dimension on

## Main issues:

- ⊕ mathematical and not a geometrical way for solving the problem
- ⊕ consequently, it is not possible to have a graphical representation after the third dimension
- ⊕ it is possible to calculate the performance value for any number of dimensions, also for 3D perspective systems, with no differences in results
- ⊕ it respects the *dimensional principle*

# Applicability of the QEST/LIME models family

QEST	QEST nD	QF	QF <sup>2</sup> D	LIME	Scope					
					[1] Quant	[2] Qual	[3] Single phase	[4] All Phases	[5] 3 dim	[6] n dim
*		*			*	*	*		*	
*			*		*	*	*		*	
	*	*			*	*	*			*
	*		*		*	*	*			*
*					*		*		*	
	*				*		*			*
		*				*	*		*	
			*			*		*		*
*		*		*	*	*		*	*	
*			*	*	*	*		*		*

[1] **Quant**: Quantitative assessment

[2] **Qual**: Qualitative assessment

[3] **Single phase**: the selected method has been applied just to a single project phase

[4] **All phases**: the selected method has been applied to all the project phases

[5] **3 dim**: the selected method is applicable to 3 viewpoints

[6] **n dim**: the selected method/technique is applicable to n viewpoints

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# Conclusions & Next Steps

- Evolution of the measurement process, from mono-dimensional **analysis** to multidimensional **performance analysis**
- Several representation techniques are used, in particular the 2D ones (such as Kiviat graphs), that miss often a portion of related information and do not respect the dimensionality principle
- Our proposal is a (at least) three dimensional family of models for measuring software project performance: the so-called QEST/LIME family
- **LIME** (**L**ifecycle **M**Easurement) Model will represent a dynamic multidimensional model for software performance measurement - extends concepts from **QEST** model using a generic 6-steps waterfall SLC model
- The evolution of the basic QEST model is **QEST nD**, extending its concepts to a generic number of  $n$  perspectives.
- According to the kind of needed assessment, an application table shows the proper component/model of the QEST/LIME family to use



# Conclusions & Next Steps

**QEST/LIME** page on the Internet (overview description, full bibliography, downloadable forms...) is available at:

[Http://www.geocities.com/lbu\\_measure/qestlime/qestlime.htm](http://www.geocities.com/lbu_measure/qestlime/qestlime.htm)

# Question Time



Thank you for your attention!

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