

From METEOR 1988 to ANONYMA 2013

**Analyses of traditional powering trials  
with the bulk carrier ANONYMA  
in ballast at two trim settings**

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The complete analyses, the 'letter' and all related discussions etc are to be found  
under 'News on ship powering trials' on the website [www.m-schmiechen.de](http://www.m-schmiechen.de)

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The primary reason for my recent, intense activities related to the analysis of ship powering trials has been the request to re-analyse the data of trials with a bulk carrier in ballast at two different trim settings using my rational methods.

As in former projects the purpose of the exercise was trustworthy to confirm numerically predicted differences full scale. I have neither been involved in the predictions, nor in the trials, nor in the assessment of my results.

The analyses turned out to be extremely delicate, forcing me thoroughly to re-think my rational conventions and throw further ballast, *i. e.* professional superstition over board.

The insights gained during that work have been discussed continuously with Dr. Klaus Wagner and following his suggestion have been described in a paper. My thanks are also due to Dr. Karsten Hochkirch of FutureShip, Germanischer Lloyd Group, for critical impulses, particularly for granting the permit to publish all details of the analyses.

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### **Further recent motivations**

The 25th anniversary of my propulsion tests with METEOR in the Greenland Sea, November 1988,  
the 15th anniversary of a proposed rational standard for the assessment of trials, April 1998,  
the overdue revision ISO 15016: 2002-06,  
the 'incredible' STA-method promoted by MARIN,  
its premature integration into the 'ITTC 2012 Guidelines',  
their *approval contra legem* by the Executive Committee,  
and their submission to MEPC of IMO.

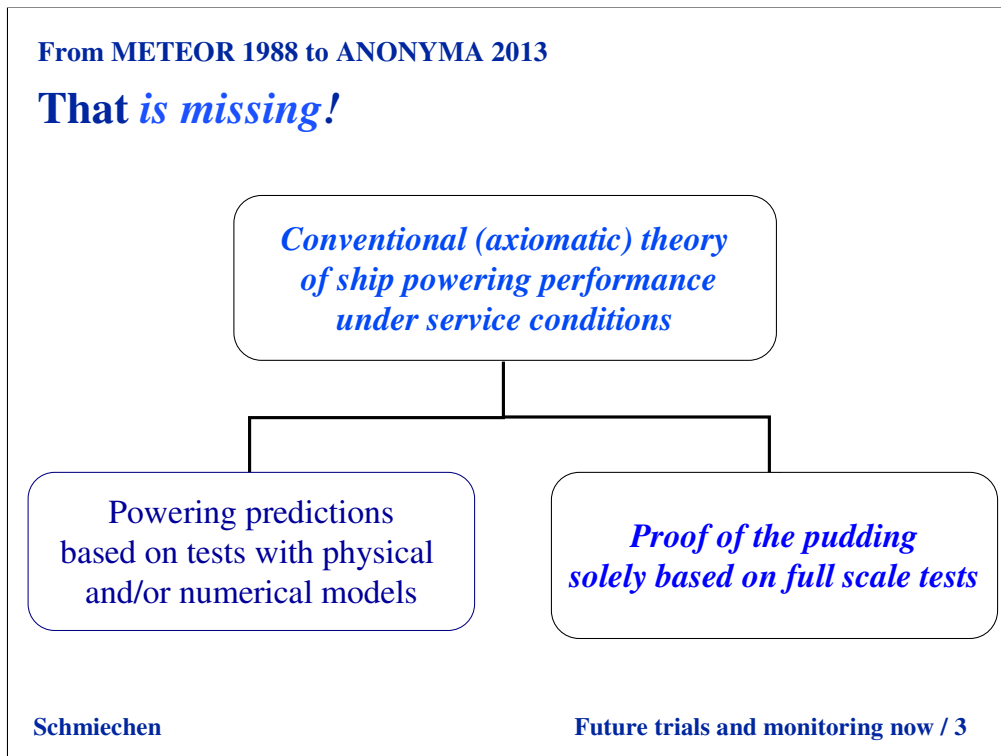
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In view of the many other recent grounds my paper, in the style of a formal 'letter' to my colleagues and students, has become much more elaborate than expected. The intention was to recall the well known deficiencies of the traditional methods and explain, how they can be and have been overcome based on few fundamental results of the theory of knowledge..

The letter is also addressed to all, who 'should' be interested in my work, ship-builders and ship-owners, staffs of model basins, and members of the STA-Group and of the governing bodies of ITTC, ISO and IMO.

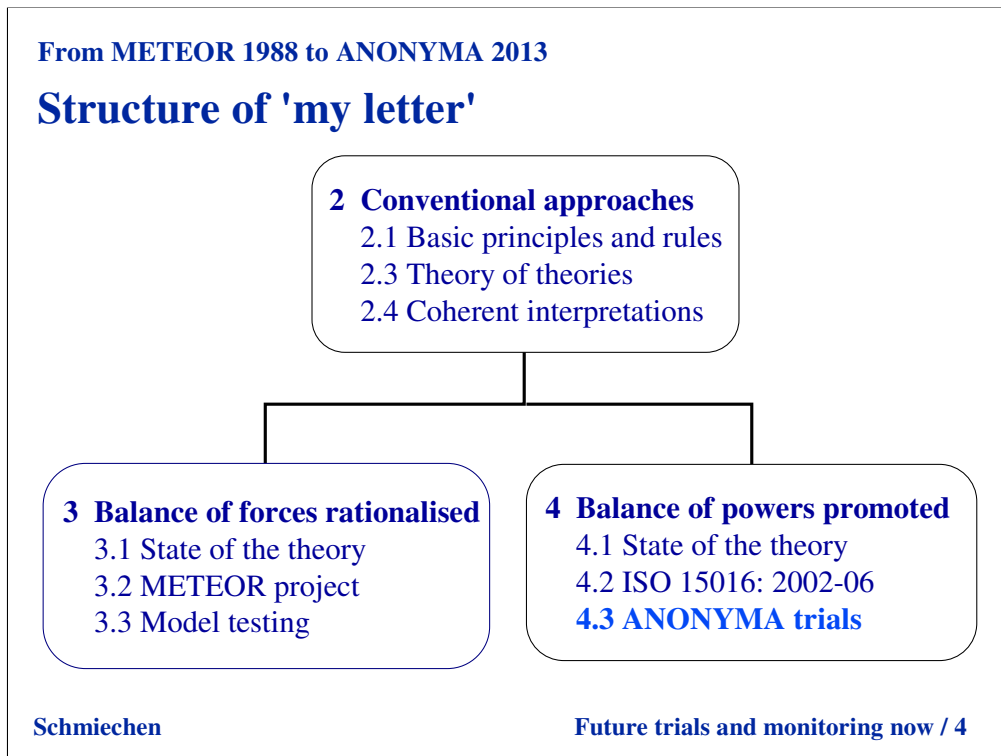
It is not my fault, that the many developments of the rational methods have been consistently ignored for decades at universities, model basins and the ITTC for the sole reason, that they cannot be phrased in the jargon of our grand-grandfathers.



At the present situation many colleagues notice at the latest, that very many methods have been developed to predict the powering performance of ships, erroneously mistaken for propulsion theory, but that except for mine no methods have been developed for the convincing, trustworthy proof of the results full scale, meeting today's, *i. e.* their own requirements.

Theoreticians have 'simply' left the very difficult problems of trials and monitoring the powering performance to practitioners at ship yards and model basins. And ship-owners still accept, that the same 'people' providing the predictions are carrying out and analysing the trials 'as well'.

I just mention by the way, that the rational theory is a powerful tool not only for the development of theories of trials and monitoring the powering performance, but also for the computer aided design of ships and their propulsors, a potential not yet exploited.



The 'letter' mentioned has the same structure as the theory with all its branches and their development and successful tests over the past 25 years. The analyses of the trials with ANONYMA marks the end of that development so far.

But many of my expositions start with the theory of traditional trials, so in my opus magnum, clearly and unmistakably demonstrating that the evaluation of trials does not require any theory of propulsion, but only some elementary mechanics, some common sense and, last but not least, extreme care, often to be missed, in evaluating the valuable data acquired at considerable costs.

This short lecture has to be limited to two examples of traditional trials as usually performed, i. e. without the measurement of thrust, without the measurement of hull speed through the water and without the measurement of sea states. A more extended presentation is to be found on my website.

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## 2.1 Rational conventions

**Conventions are agreements, are languages and their implications (to be) agreed upon.**

- **Traditional conventions** are usually not explicit, often incoherent languages.
- **Rational conventions** are formal languages constructed *ad hoc* for the purposes at hand. In terms of logic they are axiomatic systems, a frightening name for most useful tools.

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But for understanding the following some meta-theory is necessary here as well. The misconception, that one can get along without such theory, without 'philosophy' is entertained only by colleagues, who most urgently need these theories to solve their own very difficult problems professionally.

Whatever we as humans undertake jointly, *e. g.* the theory of classical mechanics in general or the theory of ship propulsion in particular, is based on conventions. This fact and its consequences are hardly known to physicists and engineers, although only that knowledge permits efficiently to solve problems, *i. e.* free of traditional ballast.

The grammar and the usage of formal languages are usually known only rudimentary. As a consequence much research is quite inefficient, if not irresponsible waste of intellectual and financial resources.

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### **Lessons (to be) learned**

The most fundamental task is to *set up rational conventions adequate for the purposes at hand and so simple and self-evident, that they and their consequences are acceptable for the all parties interested in the results.*

The interpretation of the concepts and parameters introduced to be completely separated from the construction of the axiomatic models, of the formal languages proper.

*The concepts and parameters introduced to be identified only in the contexts of elementary mechanics and of the models or languages adopted.*

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Earlier, giving talks at the Institut für Schiffbau in Hamburg, whenever I introduced a concept, I have been interrupted instantly by the question: 'and how are you measuring it?' That this conception is hopelessly naive and antiquated, is hard for naval architects to understand.

The concepts and their interpretation, inherited from our grandfathers and still in use, did not fall from heaven and happen to be not applicable under service conditions. Their meaning and values are obtained only in the context of conventions, *i. e.* 'reference systems'.

'Independent' interpretations require additional, totally unnecessary conventions 'without end', resulting in an infinite regress. Example are meters of any type that cannot be calibrated.

And conventions are appropriately designed for the purposes at hand, so that the values of the concepts introduced can be identified under any condition. An example is my thrust deduction convention permitting to identify the resistance of ships not only on model scale in a towing tank, but full scale under service conditions as well.

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### Delivered power convention

As 'local' model of the *powering performance of the propeller in the behind condition* I have used from the beginning of the development the 'pump' function

$$P_S = p_0 N_S^3 + p_1 N_S^2 V_H$$

relating the supplied shaft power  $P_S$ , shaft frequency of revolutions  $N_S$  and hull speed through the water  $V_H$ .

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In the light of this short, but necessary introduction the details of the analyses of the trials with ANONYMA are as follows.

By their nature propulsors are pumps. And thus to treat them accordingly offers dramatic advantages, not only in evaluating trials. I only mention the design of hull integrated propulsors, *e. g.* ducted propellers. In that case all (!) the interactions are treated implicitly, no prior values have to be sucked from thumbs.

If as usual only power measurements can be performed, then only the power ratio as function of the hull advance ratio can be identified. But if reliable thrust measurements are possible, as in the cases of models and of the METEOR, all interactions between hull and propeller may be identified. The corresponding ideas and suggestions by Fritz Horn and the related model tests at various basins have already been discussed at the 4th ITTC 1937 in Berlin.

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## Speed through the water

The hull speed over ground and through the water are related by the current velocity  $V_C$  prevailing at the time and location of the trials

$$V_H = V_G - V_C \cdot$$

**Thus the parameters of the propeller powering function in the behind condition cannot be identified trustworthy unless the current velocity is determined reliably as well.**

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If responsible hydrodynamicists cannot reliably identify the flow velocity, then they instantly and unconditionally disrupt any further evaluation.

This has not been done by naval architects fifteen years ago. Although in 1998 I had demonstrated serious deficiencies concerning this fundamental aspect in the draft of ISO 15016, the latter has been accepted as standard in 2002 by all national groups informed.

And in the STA method of MARIN the current is still identified in that inadequate way.



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### Current convention

In many cases the current may be conceived as a mean constant current superimposed by a harmonic tidal current. And the simplest convention adequate in this case is the two parameter model

$$V_C = v_0 + v_1 \sin [\omega_T (t - t_T)]$$

with the 'universal' circular tidal frequency  $\omega_T$  and the time of high tide  $t_T$  at the day and the location of the trials, known from the tidal tables.

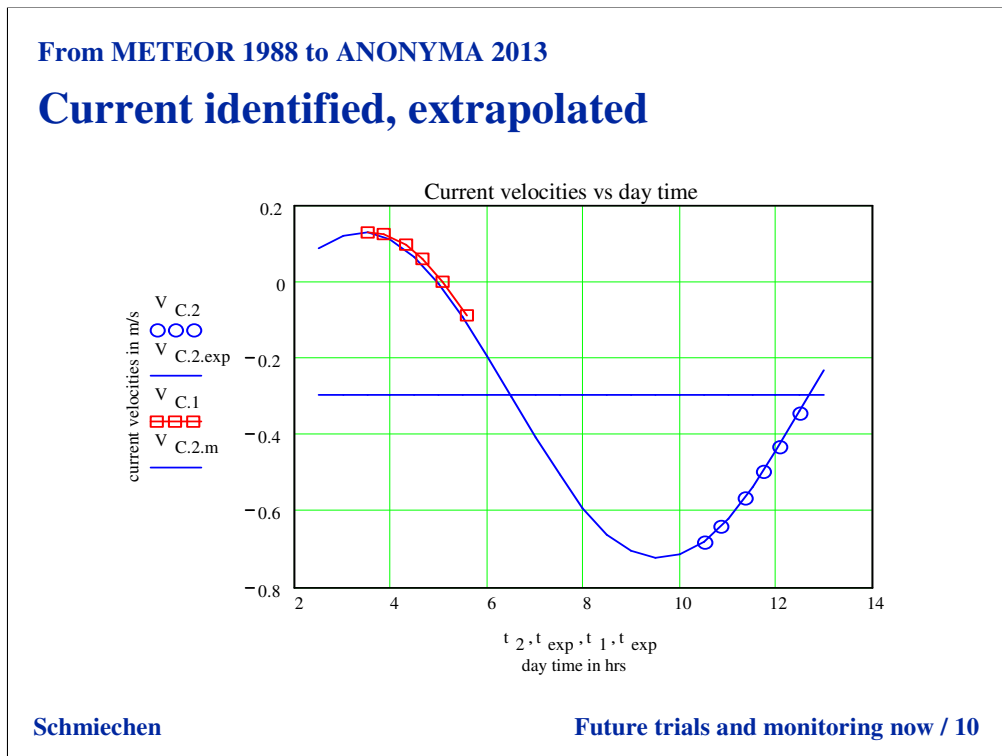
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The propeller and the current conventions have two parameters each. Due to the linearity of the propeller convention, adopted in view of the limited range of hull advance ratios, these four parameters can be jointly identified as solutions of one set of linear equations.

Prerequisite is are adequate routines based on singular value decomposition. Do-it-yourself routines are not sufficient in case of nearly singular problems.

The example of ANONYMA demonstrates, that any trial is a special case, not adequately to be treated according to some recipe. Thus some conventions have to be agreed upon *ad hoc*. If *e. g.* the assumption of a tidal current is not appropriate, an adequate convention has 'simply' to be adopted.

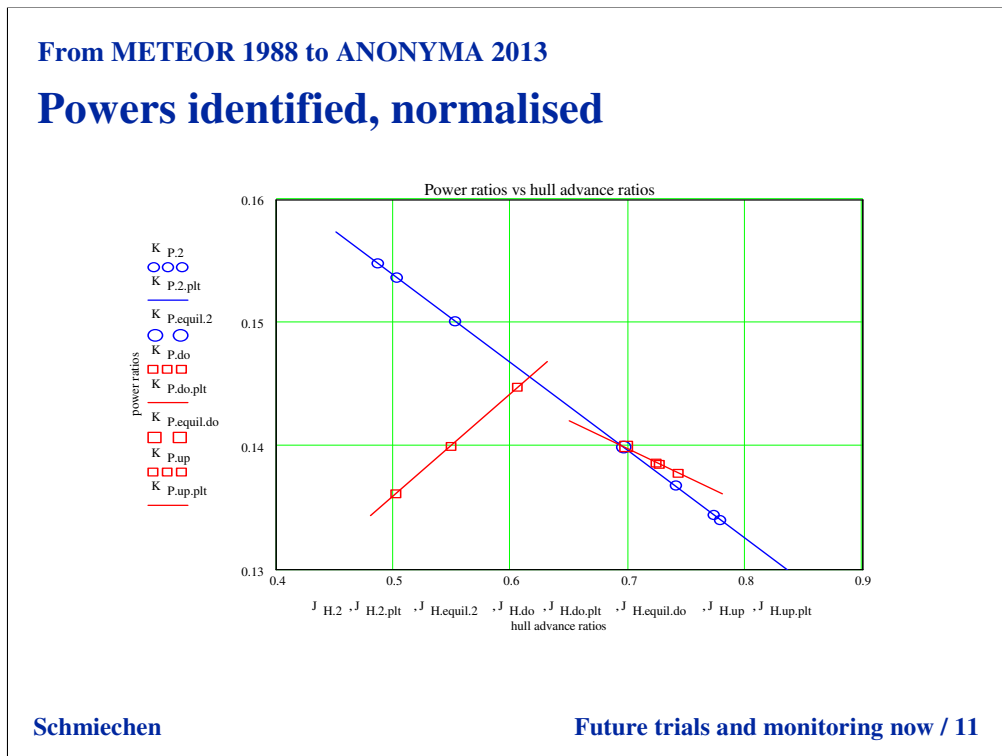


My propeller and current conventions have often proved to be extremely sensitive probes. Whenever the application produced unrealistic results, these could be traced to some problems in the input data. In case of the ISO example I have thus detected a misprint in the data. In case of the ANONYMA the situation was more intricate.

The evaluation of the first trial, that with the smaller trim and thus smaller nominal propeller submergence, 'did not work'. But the reason for some unlikely data remained of course obscure.

The evaluation of the second trial, that with the larger trim posed no problems at all. Subsequently the 'only' problem was reliably to extrapolate the current for the location and the time of the first trial. This problem could be solved as described referring to the tables of tides.

According to a crude estimate the current was 'just' negligibly small. Evidently this is true only in the average, while during the trial the current changed by more than half a knot!



The result of both trials clearly show the reason for the failure of my simple, over-all analysis of the first trial with the smaller nominal propeller submergence. The propeller ventilated during the runs up-wind! And as a consequence the extrapolation of the current became necessary.

Results of 'standardised' evaluations, *e. g.* according to ISO 15016 or the STA procedure of MARIN, *contra legem* integrated into the 'ITTC 2012 Guidelines', are of course completely non-sensical.

In principle all references to the performance of deeply submerged model propellers, as in most traditional methods, or to the propulsive efficiency observed in model tests, as in the STA procedure, are unacceptable, as they require any number of additional conventions and parameters, which the observer has to or may suck from his thumb 'as required' for his (!) purposes.

The way the STA procedure is sold as 'industry standard' is for my taste a particularly drastic example of Andersen's archetypal tale of 'the emperor's new clothes'.

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### Required power convention

In case of the ANONYMA the two parameter 'required power convention'

$$P_R = q_0 V_H^3 + q_1 |V_{W,rel.x}| V_{W,rel.x} V_H,$$

which I had used many times before, turned out to be 'perfectly' adequate to model the data in the confidence range.

The 'environmental parameters' of the partial powers unambiguously, 'objectively' identified have nothing, to stress: definitely nothing whatsoever, to do with the 'resistance coefficients' traditionally considered in this context.

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That environmental influences can be identified only after the reliable identification of the speed through the water is self-evident practice for all experts. Only in the procedure marketed by MARIN the opposite is advocated, maybe due to the fact that the current cannot be identified trustworthy.

Using my simple convention it is sufficient to solve another system of linear equations. In view of the few data available down wind, the environmental parameters for the first trial, that with the smaller trim, could not be identified reliably. Thus the values identified for at the second trial have been used as well.

Addition 21.09.2013

Dott. Gennaro as well as Dr. Wagner have already pointed out, that the convention used is not generally acceptable. I shall try any other proposal, provided the data available are sufficient for that purpose!

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### **Nominal no wind and waves condition**

The required power convention permits further to define the nominal no wind and waves condition

$$P_{RNoW} = (q_0 + q_1) V_H^3 \equiv C_{PV} V_H^3 .$$

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For the whole day of the trials only the constant wave height of 3 m has been 'observed'. Thus the comparison of the powers may be acceptable.

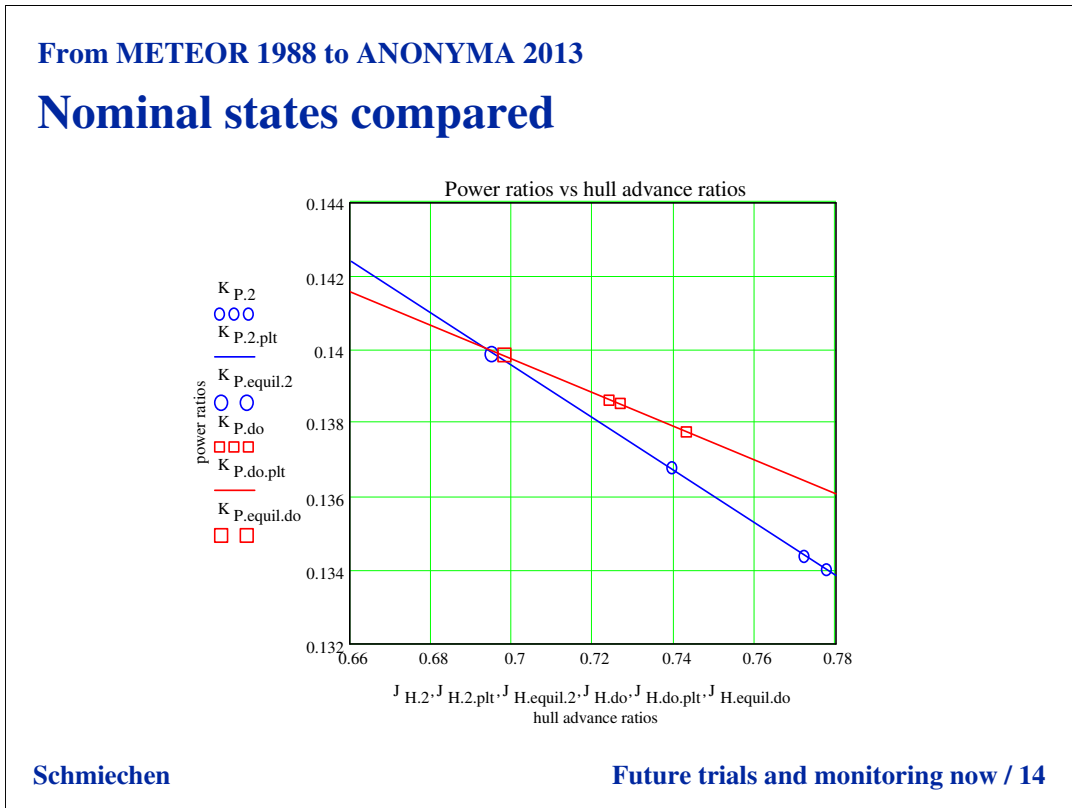
If more detailed observations of the sea state have been available I have always accounted for them as far as possible.

Addition 21.09.2013

The correct title should of course have been 'nominal no wind condition', as all measurements at both took place at the wave height reported.

Addition 06.10.2013

Decisions for one of 'equivalent' conventions, all resulting in residua within the confidence interval of the data, are possible only by additional conventions, as has been shown in detail in the evaluation of the trials at the larger nominal propeller submergence.



Though the difference of the powers at both trim settings at the nominal states is significant, it is very small compared to the confidence intervals, that it can safely be considered as negligible.

But as the plot shows the influence of the nominal submergence identified is considerable.

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## Warning!

**Reading of my  
papers endangers  
Your principles!**

"You cannot have a theory without principles.

**'Principles' is another name for 'prejudices'."**

*Mark Twain: 'The Disappearance of Literature'*

*Speech, 20 November 1900.*

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And here at the end I am back at the start!

The present situation concerning the methods of powering assessment is *e. g.* comparable to the recent situation in some Arab states. If majorities, hopefully not only illiterates forced to the urns, vote for the traditional 'prejudices', conventions inherited and accepted so far, then rational conventions, more adequate for today's purposes, will be accepted only by the next generations.

Of course many people are not interested to have their intact worlds and their profitable businesses disturbed. But if the STA method, meeting none of the requirements stated, will be adopted by the 27th ITTC 2014, it will not only impede or even prevent progress for the next decades, but seriously damage the reputation of the ITTC..

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## Justice for Hedgehogs

In his fundamental book 'Justice for Hedgehogs' Ronald Dworkin has tried to outline how the conflicts mentioned may be solved rationally, if including scientific conflicts I just try to find out.

He refers to the 'insight' of Archilochos (680 – 654 BC):

**"The fox knows many things,  
but the hedgehog knows one big thing!"**

The hedgehog knows, *that all 'things' and how and why they are related to and depend on each other, mutually supporting each other.*

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From a poem published in DIE ZEIT (68 (2013) 38, 52) I quote the following lines, although the last line is definitely not correct:

"We are responsible for  
the states of the whole,  
not for the details."

"Wir sind für die Zustände  
des Ganzen zuständig,  
nicht für die Details."

And in due modesty I close with a remark by Jean-Jacques Rousseau:

"I would not be so arrogant to teach people,  
if I did not see, how others are misleading them."

And as many of us have been brought up with conceptions inherited from our great-grandfathers and students, who could be my grandchildren, are still indoctrinated that way, I am already working for the generation of my great-grandchildren, that is for the generations of the children and grandchildren of my students.



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## **DNV GL Merger, effective Sept. 12, 2013**

**"Standards are improving, but there is a lack of international governance. The industry needs strong, independent players that promote greater openness, consistency and effectiveness in the profession and push the development of new adequate measures and standards. For our part, DNV GL, must take an active stance and show that we have qualified opinions on technical, operational, environmental and risk management issues. We aim to deliver technical solutions that are practical and in the best interests of our customers and other stakeholders."**

*Henrik O. Madsen, CEO of the DNV GL Group.*

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These remarks of the Chairman of the DNV GL Group explicitly highlight the fact, that the problems I have addressed do not belong into some esoteric realm, but are pressing, being of urgent practical importance.

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**Future trials and monitoring now!**



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