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Health and Safety in Construction

Santé et sécurité dans la construction

Gesundheit und Sicherheit im Bauwesen

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SUMMARY
«Healty and Safety» proves to be a great problem in the construction industry all over the world. Statistics give only a view on the number of accidents, not on the unsafe situations during construction; the figures given by different countries are often unreliable, they are not comparable. Safety-planning and Risk-analysis should be used as a tool of safety management. This report is a summary of both the author's paper presented at the Seminar in Tokyo and the papers presented by the Japanese experts on that occasion.

RESUME
Le thème «santé et sécurité» est un grand problème dans l'industrie de la construction dans le monde entier. Les statistiques ne donne qu'une vue du nombre des accidents mais ne parlent pas des situations dangereuses pendant la construction. Des valeurs données dans différents pays sont souvent peu sûres et ne sont pas comparables. Le concept de sécurité et l'analyse du risque devraient être employés comme moyen de gestion de la sécurité. Ce rapport est une version condensée de l'article «Santé et sécurité dans l'industrie du bâtiment», présenté par l'auteur lors du séminaire AIPC à Tokyo et des différents articles présentés par les experts japonais à cette occasion.

ZUSAMMENFASSUNG
Das Thema «Gesundheit und Sicherheit» ist ein grosses Problem für die Bauindustrie auf der ganzen Welt. Die Statistiken erfassen bloss die Anzahl Unfälle, sprechen aber nicht von den gefährlichen Situationen während der Bauausführung. Werte, die verschiedene Länder abgeben, sind oft nur wenig sicher und auch nicht vergleichbar. Sicherheitskonzepte und -analyse sollen als Werkzeug für die Behandlung von Sicherheitsproblemen dienen. Dieser Bericht ist eine zusammengefasste Version des Artikels «Gesundheit und Sicherheit im Bauwesen», der vom Autor anlässlich des IVBH Seminars in Tokio vorgetragen wurde, und der verschiedenen von japanischen Experten bei dieser Gelegenheit vorgetragenen Artikel.

1. HEALTH AND SAFETY

1.1 Safety

Perhaps it is good to start with some slogans, we can meet when we are studying this subject: Health and Safety in Construction:

- "Safety is no Accident .....!"
- "Safety is up to you .....!"
- "Don't be half safe .....!"
- "Be alert .... stay alive ...!"

Are those slogans 'lip-services' or real accident preventions? We can not solve our problems with only bringing slogans to the building-sites!

Safety must be a basis-component in the management-philosophy of our company, in our work on the sites, in our cooperation with partners in the construction process.

1.2 Is safety a problem?

When we think about this subject, we soon shall realize that we have a great problem: the construction of building and civil works in far more unsafe than we are willing to know.

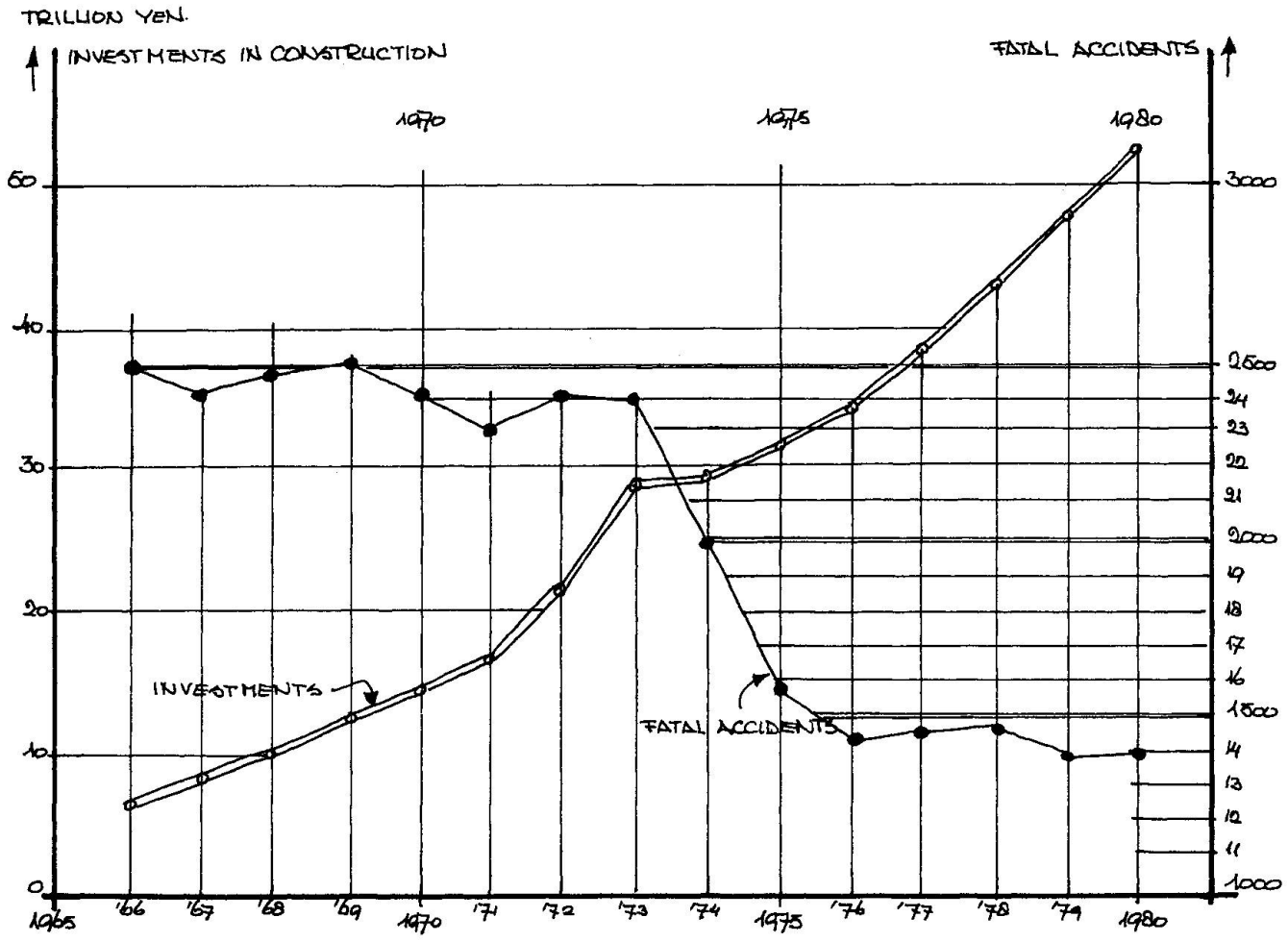

Fig. 1 Trends of construction investments and fatal accidents at work, Japan (Paper Mr. Mino)

Mr. Mino showed us in his paper a picture, which gives a relation between the investments in construction in Japan and the amount of fatal accidents, during the period 1966-1980.
We see the investments raise from about 0.75 x 10 trillion Yen to over 5 x 10 trillion Yen and a decrease of fatal accidents from about 2500 a year to some 1400 a year. With a decrease from + 2400 to + 1600 fatal accidents during 1973-1975, the period in which new legislation on occupational health became into action (fig. 1).

Also Mr. Itoh showed some graphs, in which he gave an impression about the fatal accidents in the construction industry in relation to those in the whole industry in Japan (fig. 2): we see that the construction industry takes + 40% of all fatal accidents in the whole industry! He showed us also, the lines which give us the rate of serious (inclusive fatal) accidents to every 10,000 workers in industry: we see (fig. 3) that this rate for our construction industry is 2.5 times higher than in the total industry.

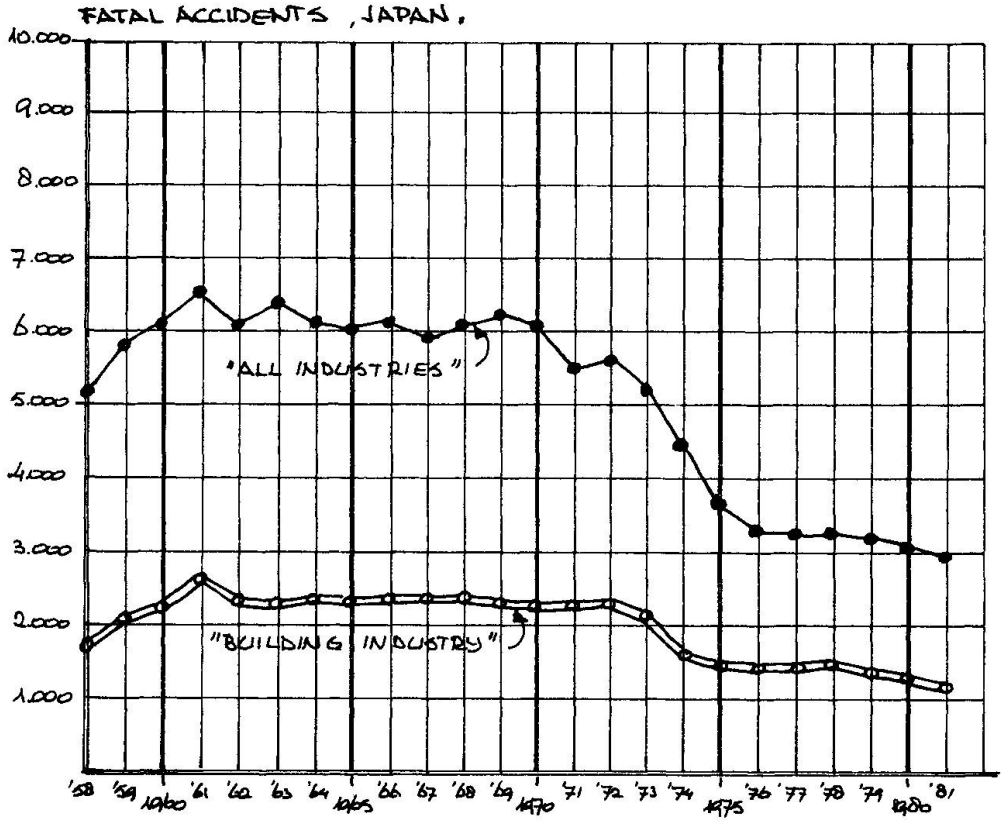

Fig. 2: Fatal accidents in all industries and in the construction industry, Japan (Paper Mr. Itoh)

Seeing those pictures and reading their papers, we can conclude that Japan has a problem when we talk about safety in construction work.

But it is not only Japan, that has this problem: all over the world we meet such terrible figures!

In figure 4, I give some figures from Europe: in some years between 1977 and 1981.
The figures gave some impression, but we cannot compare them. Every country has its own way to make their statistical reports; even 'fatal' gives figures which are not quite correct: when death occurs after some more months, this is sometimes not counted to the fatal accidents! Also the number of accidents often differ, because of the fact that in some countries the first day of absency after an accident is already counted and in other countries thay start to count after 4 days or more.

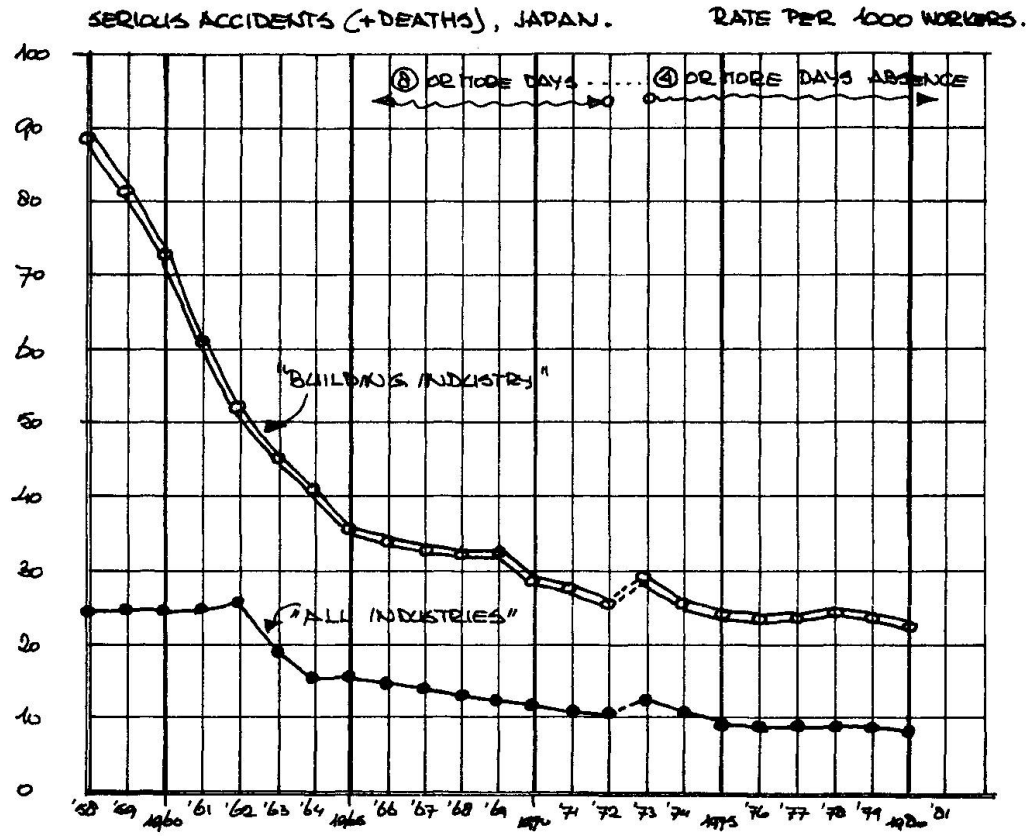

Fig. 3: Serious accidents, incl. fatal accidents, Japan; rate to every 1000 workers (Paper Mr. Itoh).

IN ONE YEAR BETWEEN 1977–1981	WORKERS:	ACCIDENTS:	FATAL:
NETHERLANDS:	± 350.000	± 25.000	30
JAPAN:	± 4.000.000	± 100.000	1200
GERMANY:	± 2.000.000	± 250.000	390
SWISS:	± 320.000	± 82.000	86
ENGLAND:	?	± 30.000	127

Fig. 4: Some data about unsafety .....

And from Scandinavia I got figures from which the writer told me to multiply them three times to get some idea about the real figures .....!

So we can conclude that we have a great problem in our industry and that this problem is perhaps still bigger than we know now!

1,3 Safety and Costs

When we read in literature about chapters of our problem field, we always meet the discussions about safety and costs.

Let us try to think about these relations in the way I put it down in figure 5:
When we speak about construction we always have to do with certain working situations. And we all know that during construction on the sites and in our manufactories we meet certain dangerous situations.

Out of these dangerous situations incidents and accidents occur and we try to work in a safe(r) way by making prevention programs. Both with management and the workers we have to reckon.
Incidents and accidents originate certain costs, counted in a direct and in an indirect way.
Also safety-measures will ask certain costs, certain investments. The less safety measures the more accidents can occur: the total costs will be high.
More safety-measures will give less accident costs but more safety measure costs. We think the total cost will decrease.

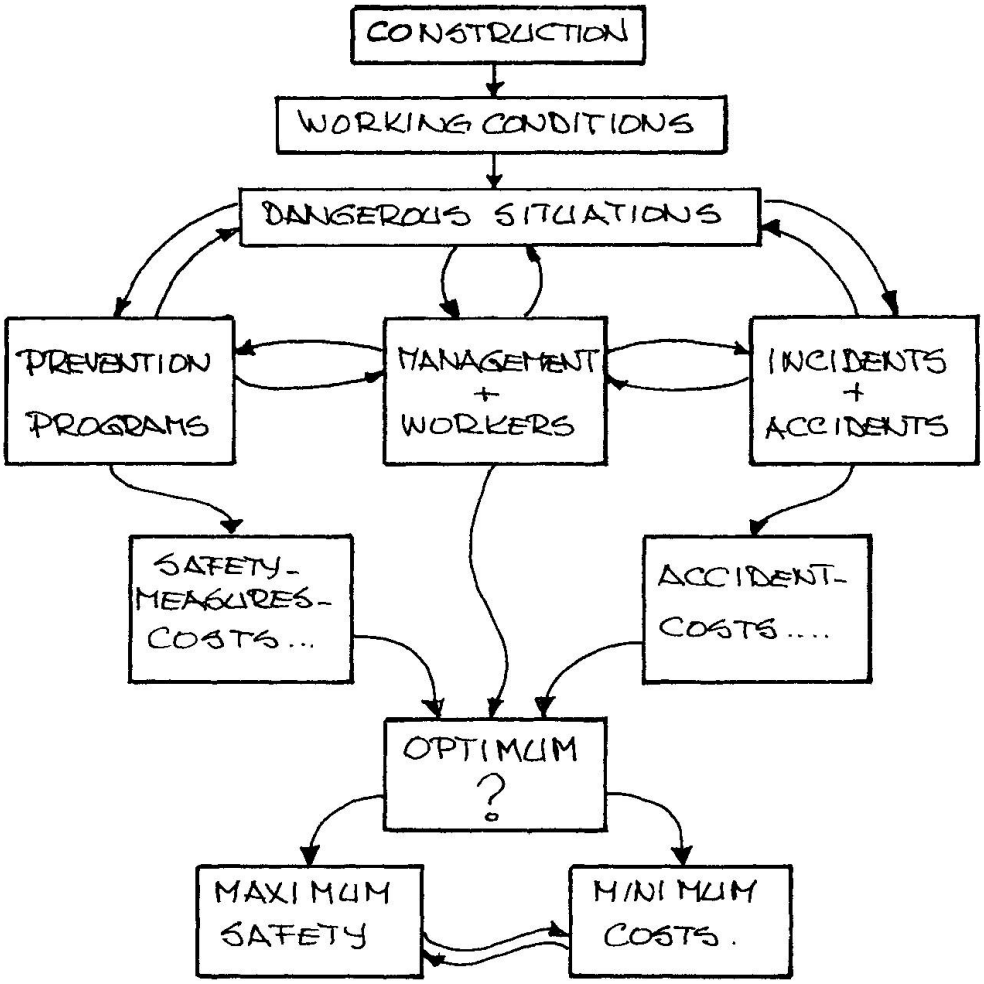

Fig. 5: Relations between safety and costs

Can we talk about some optimum?

- Perhaps we have minimum costs, with a certain amount of safety-measure-costs.
- Is there a possibility of maximum safety?

In figure 6, we put this philosophy in a graph.
- Line A is the decreasing cost-line of accidents
- Line B is the increasing cost-line of safety-measures
- Line T is the combination: total A + B costs.

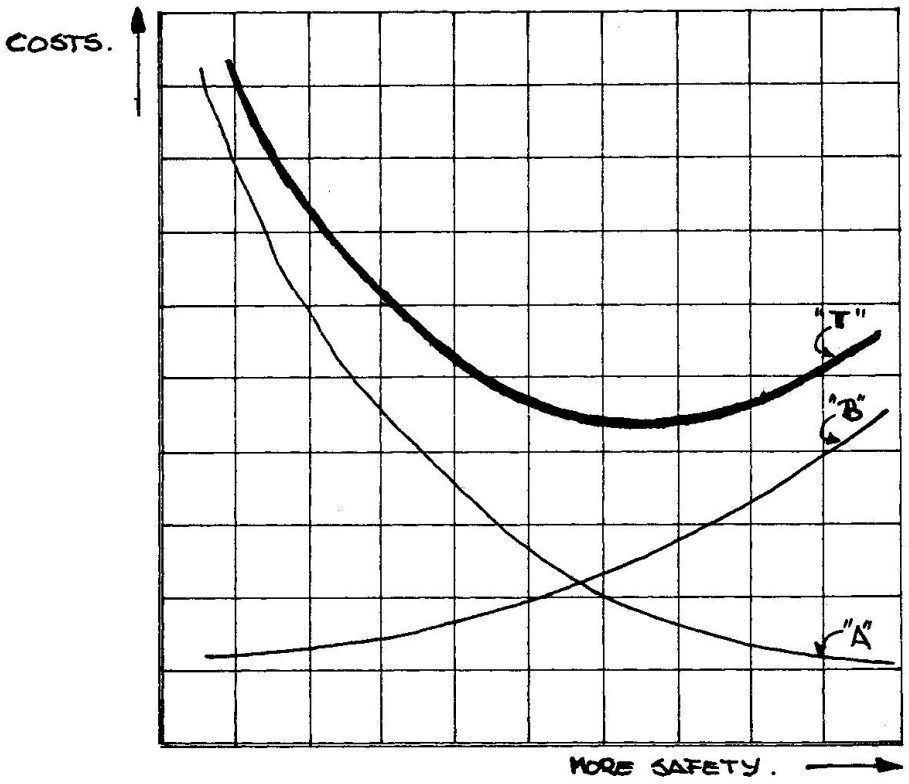

Fig. 6: Safety- and accidents-costs

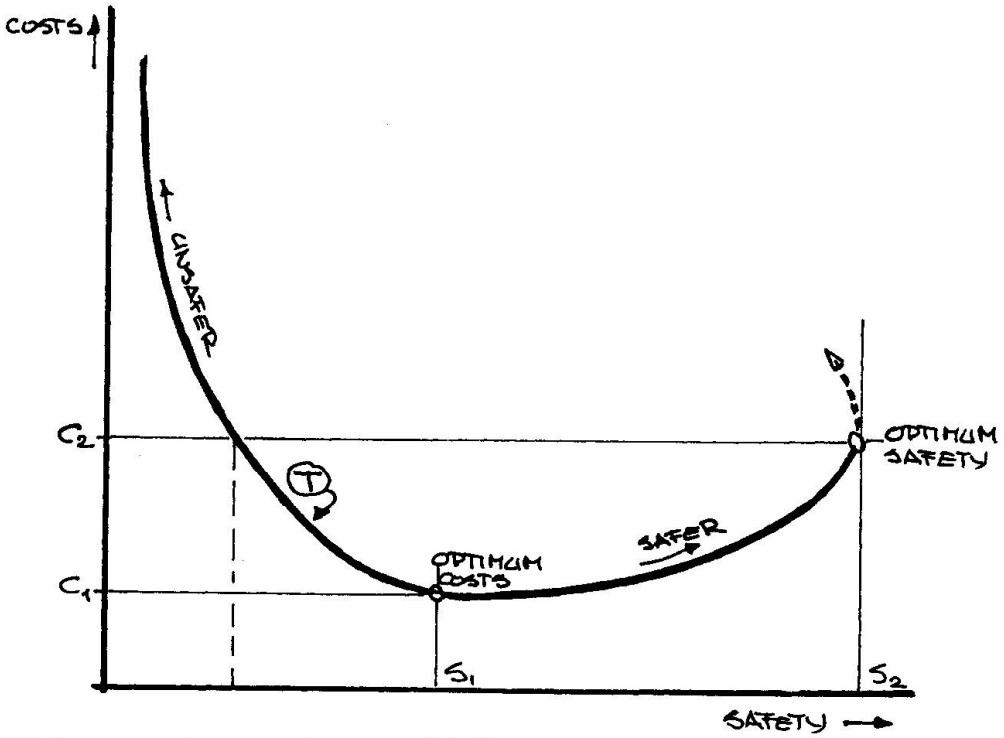

Fig. 7: Minimum costs or maximum safety?

In figure 7, we try to bring in more safety, till we reach the theoretical point of maximum-safety, when we have past the point of minimum costs. There is a question: what happens after maximum safety? People on the sites says: to much safety-measures give again more chances for accidents .....! But this is never proved by any research-study, as far as I can find out!

In figure 8 we let see that this curve will be different for each new building site: every construction work has his own problems, also in the field of health and safety conditions.

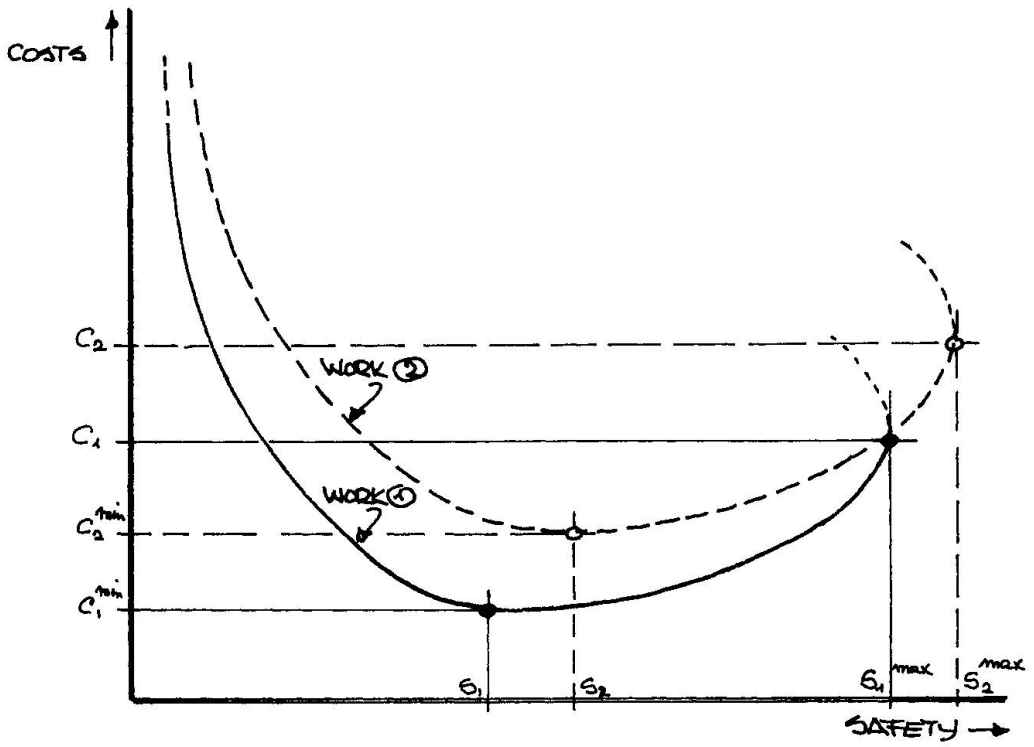

Fig. 8: Every construction site will have his own safety conditions

2. SAFE AND UNSAFE SITUATIONS

2.1 Can we foresee?

We state that there is no safe or unsafe situation in an absolute way! And we wish to say that prevention is only possible when we can foresee the unsafe situations, the unsafe working circumstances, the unsafe actions of the workers and of management.

We shall always have to weigh the chance of occurance of such unsafe circumstances. And we can do that better when we have our own experiences, when the extent in which we will be remembered to such a possibility counts, or when the imaginativeness of some kind of possible accident consists.
However, it will be extremely difficult to prevent those accidents, which never have passed before.

2.2 Backgrounds of accidents

Every accident therefore will have some background, some environment in which it may occur.

We define an accident as: A sudden default of an availability, caused by an unattended disturbance of the usual course of events, or of the fixed way of working.
These courses could be placed under the titles of: wrong methods, wrong means, wrong actions, poor working climate, poor organization, wrong mentality.
And in most of these causes we have to think in terms of 'poor management'.

2.3 Accident Statistics

When we see all the figures in the different accident statictics, we ask ourselves: why do we make these statistics? Do we really use them to make safer situations? Or are they only used for the calculation of the insurance-rates?

For what we see is just a very small part of all unsafe situations: only those unsafe situations which brought us an accident in some way or another. I wish to speak here of the 'Ice-berg of unsafety' and about all the near-accidents within unsafe situations (fig. 9).

Talking about 'Health and Safety in Construction' we have to speak about all unsafe situations; perhaps there are ten times more unsafe situations than we can count as those who came to an accident.

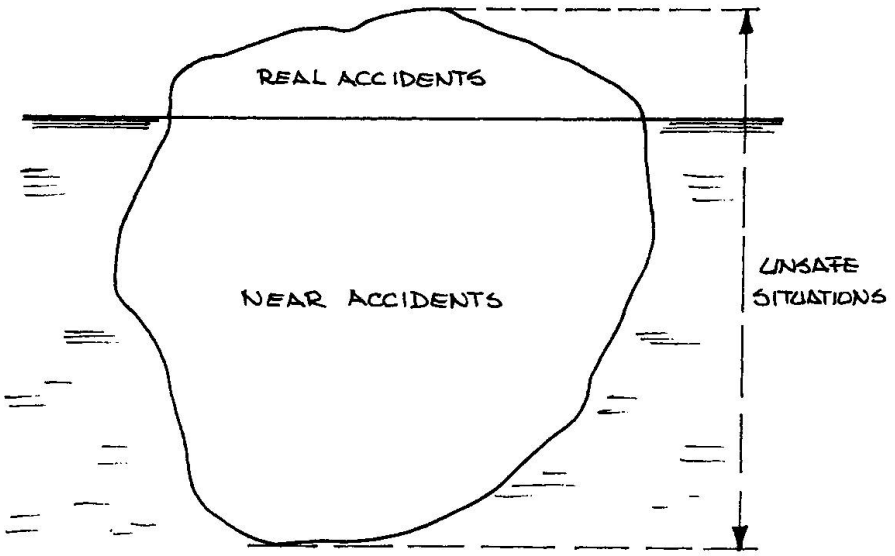

Fig. 9: The 'Ice-berg' of unsafety

2.4 Factors of influence

From American literature I bring here the factors of influence, which may cause unsafe situations and sometimes accidents.
In figure 10 we can read that each worker on the building site has some factors which cannot be influenced and some factors which can be influenced. The first factors come most from his own environment, the second come from this special job on that special site. And suddenly there comes that accident: why just now, on that very moment? Why come some unsafe situations never to an accident, why do some it now?

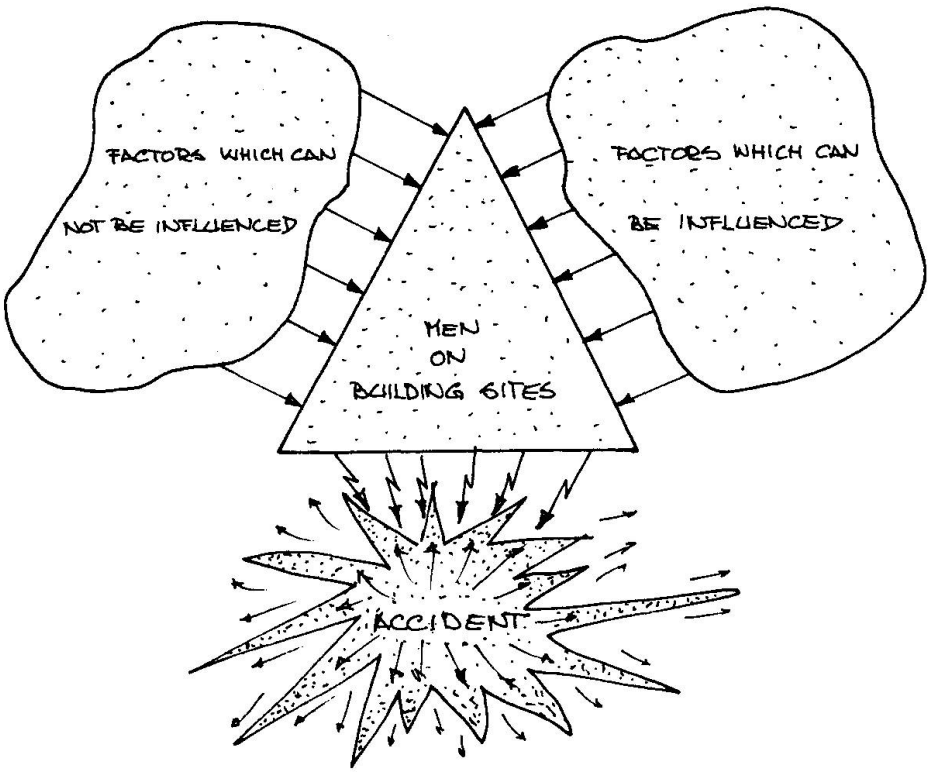

Fig. 10: Factors of influence

2.5 Sudden or slow actions?

Speaking about accidents, as a quick, a sudden default, which brings us damages and injuries, we forget that through certain unsafe working situations or actions our health can be destroyed by poison, radiation, noise, stress, ... etc. These are no sudden actions, but very slow actions and they bring the damages in our body after several years.
So our study field is much broader than only 'the accidents': it includes unsafety in its totality.

2.6 Ratios

Health and Safety belong to eachother: So if we try to think in term of ratios, we should think in:
- Accident ratios

and in:
- Sickness ratios.

All ratios used in different countries look like each-other, but they all differ in one way or another. As I said before: we cannot compare them.
The accident ratios are calculated in two ways:
- Accident Frequency (AF)

and
- Accident Heaviness (AH) or: Accident Severity.

I suggest an international ratio; which is defined:

$$A.F.= \frac{\text{number of reported accidents}}{\text{number of men years}} \times 100\ (= \%)$$

$$A.H.= \frac{\text{number of reported lost days}}{\text{total worker days/year}} \times 100\ (= \%)$$

In the same way we could count with sickness-ratios:
- Sickness Frequency = S.F.

and
- Sickness Heaviness (or Severiness) = S.H.

which could be calculated as:

$$S.F.= \frac{\text{number of reported sick-cases}}{\text{number of men years}} \times 100\ (= \%)$$

$$S.H.= \frac{\text{number of reported lost days}}{\text{number of worker days/year}} \times 100\ (= \%)$$

Still there remains the questions of:
- Reported accidents: how do we get the good figures?
- Reported lost days: in my opinion the first day of absency is already a lost day!
- The question of heaviness: in some countries they count extra lost days when the accident is less or more heavy. Of course gives this a certain information of the heaviness of such an accident, but in my opinion is it not right to do so in these ratios. I suggest to bring this information in another way.

2.7 Case

As a case study, I give the ratios as defined above of The Netherlands in round figures:

suppose:	Men years	=	350,000	(years)
	Men days	=	77,000,000	(days)
sickness	Cases	=	485,000	(number)
	Lost days	=	9,650,000	(days)
Accidents	Cases	=	18,000	(number)
	Lost days	=	450,000	(days)

Ratios:

HEALTH $S.F.= \frac{485,000}{350,000} \times 100 = 138.57\%$

$S.H.= \frac{9,650,000}{77,000,000} \times 100 = 12.53\%$

SAFETY $A.F.= \frac{18,000}{350,000} \times 100 = 5.14\%$

$A.H.= \frac{450,000}{77,000,000} \times 100 = 0.58\%$

3. THE SAFETY CHAIN

3.1 Chain of events

From Swiss we learned a lot from the "Safety chain". This means that safety consists as long all parts of a chain of events are held. But in each part we find difficulties, which bring us into certain unsafe situations (see fig. 11).

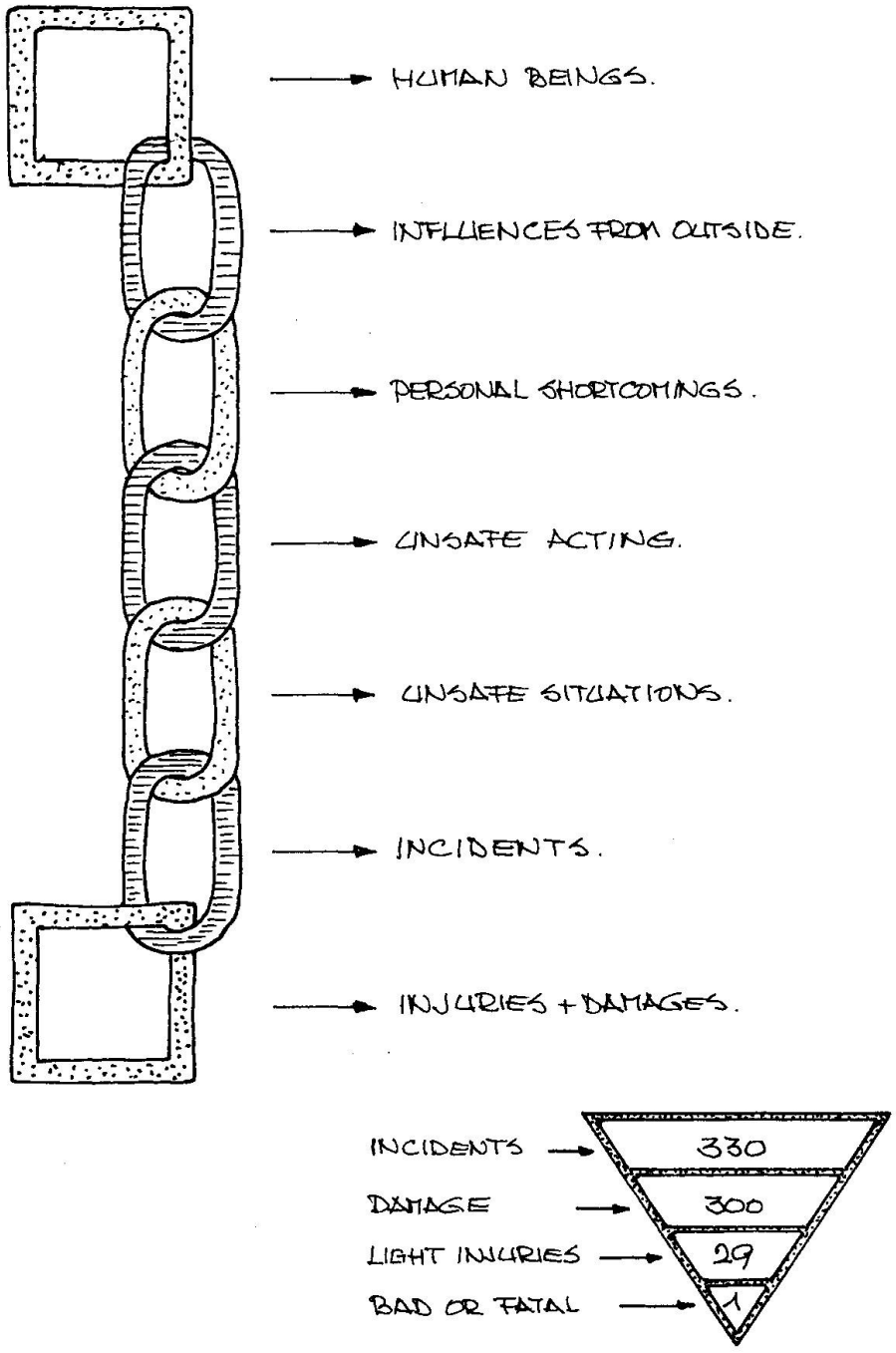

Fig. 11: Safety-chain

Every safety-chain starts with the Human-beings, it ends at last with injuries and damages. In between we meet different unsafe situations. We can bring them into groups of specialities. For instance we have to count with:

- influences from outside as: social -, family -, wheather- , ... etc. conditions
- personal shortcomings, as: not knowing, not capable to do some kind of work, not wishing to do it, wrong mentality
- unsafe actions, as:
  . unqualified activities
  . unsafe place of work
  . safety devices put out of operation
  . use of unadequate equipment
  . unsafe loading or unloading, lifting, etc.
  . unsafe working conditions, positions, circumstances
  . unsafe way of joining materials, prefabrikated elements
  . unsafe working near, on and with moving equipment
  . all kind of disturbances in the work
  . not using personal protection.

Further we meet the unsafe situations, which often can be brought back to management: we sum up:

. poor working organization
. insufficient protection
. unsafe working sites
. unsafe use of equipment
. unsafe ventilation conditions
. vibrations
. noise
. unsafe clothes, inadequate personel protections
. wrong mentality.

Then come the special events, which can bring us the incidents and accidents, with damages and injuries.

In Swiss they say that on 330 events, 300 give 'only' damages, 29 bring light injuries, 1 of those events brings bad injuries or death.

3.2 Management

What has Management to do with this?
We mention:
. Stop unsafe actions
. Investigate each unsafe situation
. Give more information and instruction
. Motivate men to do the job in a safe way
. Abolish an unsafe situation at the source
. Take protection measures
. Give on the site warnings on dangerous places through signals, colours, boards, inspections
. Give serious warnings to labourers and prosecute if necessary.

And Management has to know that it is better to take actions beforehand, than reaction afterwards. That means also: Provide safety-programs.

4. SAFETY CONCEPTS IN JAPANESE BUILDING INDUSTRY

Mr. Mino of Suimoto Construction Co, Ltd., brought us a paper handling this subject. He learned us that "safety-first" should be the starting point of all Construction Planning. He showed us the graph as I gave already in figure 1, and he explained us the change of thinking in Japan.
Till 1960, the Construction Industry was still thinking in terms of "Accident Norms". This means that but few people were concerned when accidents stayed below that 'norms'.
After 1960, the new way of work became the thinking in "safety-concepts".

Due to direct actions taken by the M.O.C. (Ministry of Construction), the Construction Industry became more aware of the neccessity of safe working-conditions. So the different kind of work brought with it the classification of contractors into several grades of capacities. And when accidents will occur, due to poor safety management, MOC do suspend the qualification of the contractor during some period of 3 - 9 months.

Mr. Mino told us also that the costs of Health and Safety measures are now $\pm$ 2.9% of the total contract sum.

5. MEASURES FOR PREVENTION OF LABER ACCIDENTS IN CONSTRUCTION INDUSTRY AND SAFETY

5.1 Develop a control system

Mr. Itoh, of the Ministry of Labour of Japan, says in his paper that the labour accidents in Japanese Construction Industry have decreased due to the efforts of all partners concerned.

However, he says, there are still more than 100,000 serious accidents and more than 1200 fatal accidents, on the labour force of $\pm$ 4.000,000 in our industry. That means 3 deaths, to 250 serious injuries, to every 10,000 men years. This rate of accidents is much higher than in all other industries.
Therefore his first conclusion is: it is necessary to develop a good control system in regard of Health and Safety.

5.2 Ratio

Mr. Itoh gives us the Japanese definitions of:

$$\text{Frequency Rate} = \frac{\text{serious accidents (+ deaths)}}{\text{total working hours}} \times 10^6$$

and of:

$$\text{Severity Rate} = \frac{\text{lost working days}}{\text{total working hours}} \times 10^3$$

The lost working days are counted as: 300/365 x calendar days of absency.

And he mentiones that for serious accidents:
- death is counted for 7500 days!
- other injuries with physical handicaps are counted for 50, 100, 200, 600, 1000, 1500, ..., 7500 days!

As I already told, I disagree myself with this way of counting injuries as extra lost working days, although it gives some information about the severines.

5.3 Divisions

Mr. Itoh gives us also a division of injured workers in some special kind of work in our industry.

injured workers	1970		1975		1978	
	total	±%	total	±%	total	±%
civil work	39,775	40	42,833	44	45,546	38
building work	48,338	48	48,200	48	64,086	54
equipment work	12,127	12	8,373	8	8,936	9
total	100,240	100	99,406	100	118,568	100
deaths	2,430	1.41	1,582	1.63	1,583	1.75

And for 1981 he finds: fatal accidents: 1173 trough following causes:

causes	number	%
falling	425	36.2
breakdown	91	7.8
collapse	97	8.3
machinery	425	36.2
electricity	48	4.1
fire, explosion	18	1.5
handling	10	0.9
others	59	5.0
total	1,173	100

5.4 Safety consciousness

At last he pleads for a safety consciousness which starts alreay in the planning phase. Therefore he askes for meetings with the official authorities of Public Works, to get a brief for the safety programs of the contractor.
The Ministry therefore give some guidelines and do examinate the safety-plans of these contractors before the work can start.

Further measurements are:
- The increase of safety of machinery
- Promotion of safety and health education
- Encouragement of voluntary prevention of accidents
- Research and development in the field of safety and health.

6. STOCHASTICAL ANALYSES OF OCCUPATIONAL ACCIDENTS AND ITS APPLICATION TO THE SAFETY PROBLEMS

6.1 Feedback from statistics

Mr. Hanayasu of the Research Institute of Industrial Safety started with the remark that about 30% of all accidents in Japanese industry, occur in the construction-industry and about 40% of all fatal accidents in industry must be counted in our construction industry. He askes himself and us: why? Is it a combination of the problems of management, the working conditions, the environment on the sites, the system of employment in the construction industry?

He states than that safety-management on each construction site would be different from other sites and from the type of work, it should be related to the site characteristics.
Because safety management seems to be difficult, he tries to find a feed back from the statistics of occured accidents to the safety performances. His paper prescribes in detail:

1. the Accident Frequency distribution of occurance
2. a stochastical analysis of occupational accidents
3. its application to the safety-problem.

with the purpose to give an answer on the question: Can we measure the safety performance in our working sites?

6.2 Zero Accident Campaign?

Starting with the accident-frequency rates, he studies on the fluctuating intervals in time between those accidents. He seeks for a useful yardstick to give expression in the field of the safety-performance on that special site, or in some construction firm.

He wants to use this yardstick as a tool of management, for planning a target for non-occurance of accidents in a certain chosen period: to avoid accidents to be taken place. So it could be possible to start a special 'Zero-Accident-Campaign'.

6.3 Study-method

Mr. Hanayasu prescribes his study within the following steps:
- Look at the occupational accidents at random in time, then it can be proved that the Accident Frequency Rate in a fixed time-interval has a Poisson-distribution.
- Look at the time intervals between the successive accidents and find now an exponentional distribution
- This exponentional distribution can be useful for safety-performance evaluation
- The probability of occurance of an accident at a particular time can now be calculated.

The conclusions are now:
- The method can be used to find out significant changes in accident situations during succeeding intervals
- The time-interval-studies can be used as a valuable yardstock for safety-analysis.

6.4 Something new!

We think this paper brings us something that is quite new in our safety and health-studies and it is worthwhile to go further with this part of our problem-field.

7. ACCIDENT PREVENTION BY MECHANISATION OF ACTIVITIES AND OF IMPROVEMENT OF EQUIPMENT

7.1 Start with cause-analysis

The paper of Mr. Miyazaki of Kaweda Industries, Inc, started with the analysis of some causes of fatal accidents in our construction industry.

So he mentioned that:
- Falling of workers causes 37% of all fatal accidents
- Falling of objects causes 6% of all fata accidents.

So 43% of all fatal accidents could be eliminated through replacing of labourers-work through machines.

And further he stated that 30% of all accidents to death are caused by:
- Defects of equipment
- Mis-manipulation of machines.

So improvement of equipment will serve health and safety in our industry.

7.2 Possible solutions

And he worked this out in his paper, when he looked to:

- Hazards in the job itself, which can been lowered through:
  - Mechanization
  - Improvement of machines
  - Central controled operations
  - Remote control of operations
  - Improvement of the working conditions
  - Symplification of the work itself
  - Manipulations with big building parts.

- Hazardous working places, which can be bettered through:
  - Prefabrication and pre-assembling at safe places
  - Strenthening and making safe of working sites
  - Remote control.

8. SAFETY PLANNING AND RISK ANALYSIS

8.1 MORT-system

In our workshop in Zurich, April 1982, we learned about the System MORT, which stands for Management Oversight and Risk Tree. This system comes from USA and was developed by W.G. Johnson in 1970 - 1973, and adapted to the construction industry by Rudolf Frei (Swiss).

Every human action brings with it some risk. Every safety protection measure and every safety program can be put out of action by men. Some risks are unpredictable; other risks are taken wilfully, because of the fact the troubles of removing the danger stands in no proportion to the persued safe situation.

8.2 Fail chances

MORT gives an idealized model of a safety-system build up from the fail chance theories and it analyses the safety system. Therefore a system should be defined as a methodological order of interdependent components, which together or alone, fulfill a function or a task in the whole, within certain circumstances and within a certain span of time.
A system also is a dynamic set of data, which alter in course of time.

In a perfect system, all components will work in such a way that they give a contribution to the total sets of goals.
In any system that does not work in a perfect way, we can meet less or more failures. Therefore we can prescribe a failure as: every factor which gives no contribution to some given goal. Failures therefore can lead to unsafe situations.

The goal of a safety program is to give a way of thinking through which the chance of the appearance of identifiable level. So we have the possibility to keep unsafe situations under control in a systematical way.

8.3 A tool of Management

So using MORT as a tool of safety-management we have a cheap, feasible method which follows step by step our management-decisions. It is nothing new, it is not theoretical, but it is a system that is tried out ....., is already used....., is not time devouring. The whole system consists of endeavoured concepts and it avoids something.
When we are thinking about damages, losses, problems, unsafe work, unsafe situations, we can think about calculated risks and about faults and wrong acting. These faults and wrong activities can lead to accidents.
Why do we come into such incidents? Could it be an output of failures in our management system? Could it be in management itself, or in the kind of risk analyses, the follow up of measurement, the policy the policy in the organization?

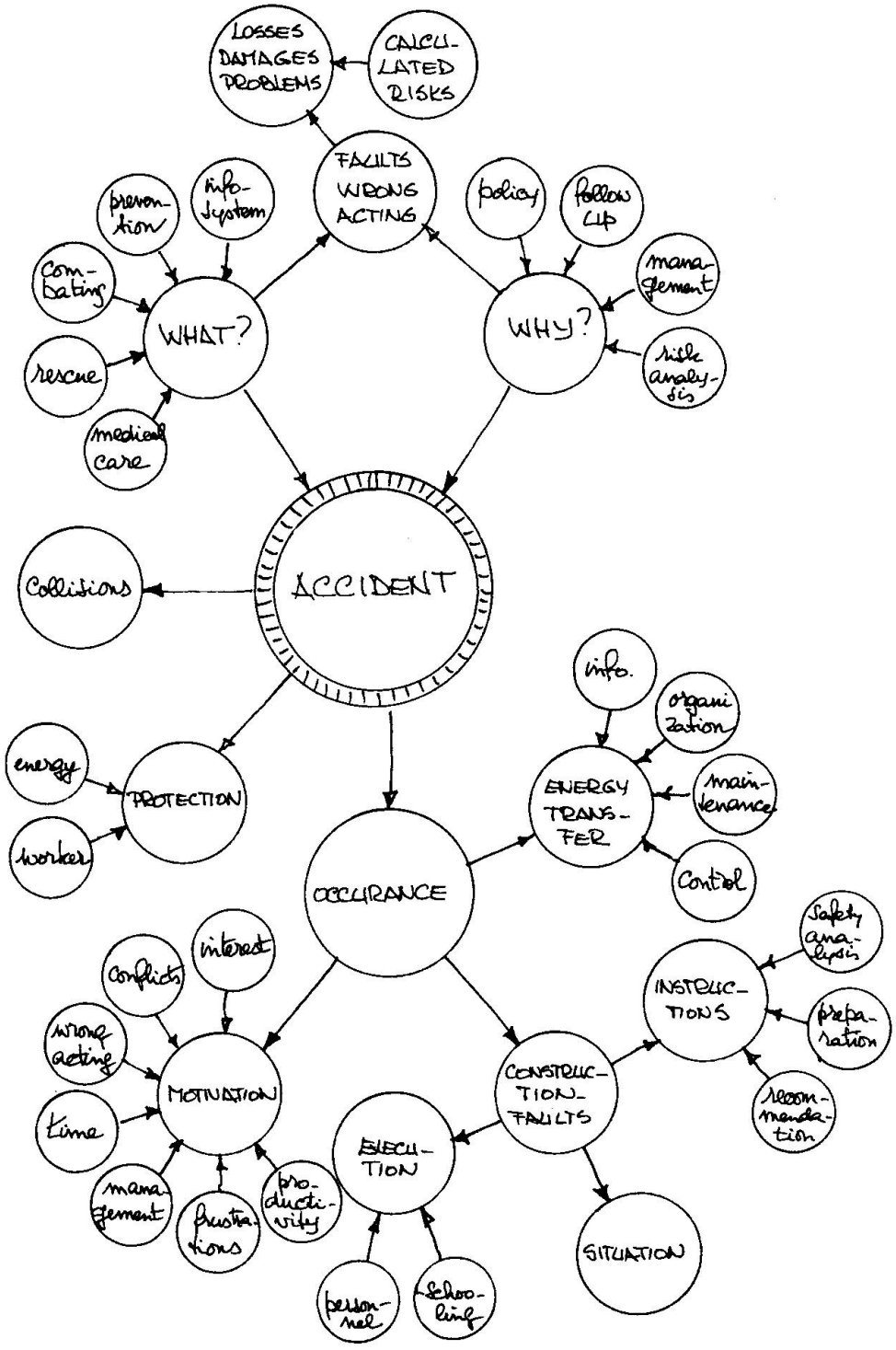

Fig. 12: Principles of MORT

What do we have to do, to prevent more problems? How works our info-system, what kind of prevention do we use; and when something happens: how do we combate the situation, how do we rescue people and what is the medical care that is foreseen?

The occurance of accidents can be thought through before:
- What to do to prevent collisions?
- What kind of protection is necessary, for the workers and for our energy-sources?
- How do we protect the energy-transfer: controle, maintenance, organization, information and instruction
- Could there be something wrong in the field of motivation of men and management: how do we handle production and productivity, frustrations of men, relations with management, time, wrong acting, conflicts and interests?
- Could there be any construction faults? How is the working situation, the excecution of work, the ability of the workers, the instructions about safety, work preparation and recommendations to work?

8.4 Safety-decision-sceme

So we come back to the work on the sites, and we recognise now again the human facotrs and the material factors. We have to analyse both of them, to weigh certain chances.
Is the risk acceptable or not? (fig. 13)
If yes, well let we do the work in the way it is prescribed and foreseen: realise the work.
If we foresee an onacceptable risk, let us not do it in that way: do not realise it.

We think this is clear, and averything is safe!
But when we take the calculated risk, there could happen something that is not wanted by us, or something happens what is not acceptable but that was not foreseen as such! In the working situation now there could happen an accident or there does not happen an accident. Now in both situations we have unsafe working conditions. Only in the case of a real accident we meet the damages and the occurence of injuries.

9. THE SAFETY PLAN

9.1 Why and What

So we come to our safety-program. We want such a safety-plan:
- To reduce human suffering
- To reduce loss of materials
- To promote morale and productivity through safe working
- To reduce insurances rates
- To reduce costs.

Such a program should cover:
- The purpose of the safety-plan
- The scope of it
- The responsibilities
- The establishment of a safety-committee, safety and toolbox-meetings
- The measurements for care and transportation of injures people
- The investigations of accidents and unsafe situations
- The accidents and incidents reports
- The feedback to the organization
- The measures for personal protection
- The instructions to be given
- The organization of safety publications
- The different plans for external assistance.

And we have to do so for the company and for each building site.

9.2 Conditions

So the safety-program and each safety-plan must be supported by the top of the organization, managed by the safety-department or assisted by an external adviser, known by every member of the organization, brought into action on each site and introduced to every newcomer and at the start of each work.

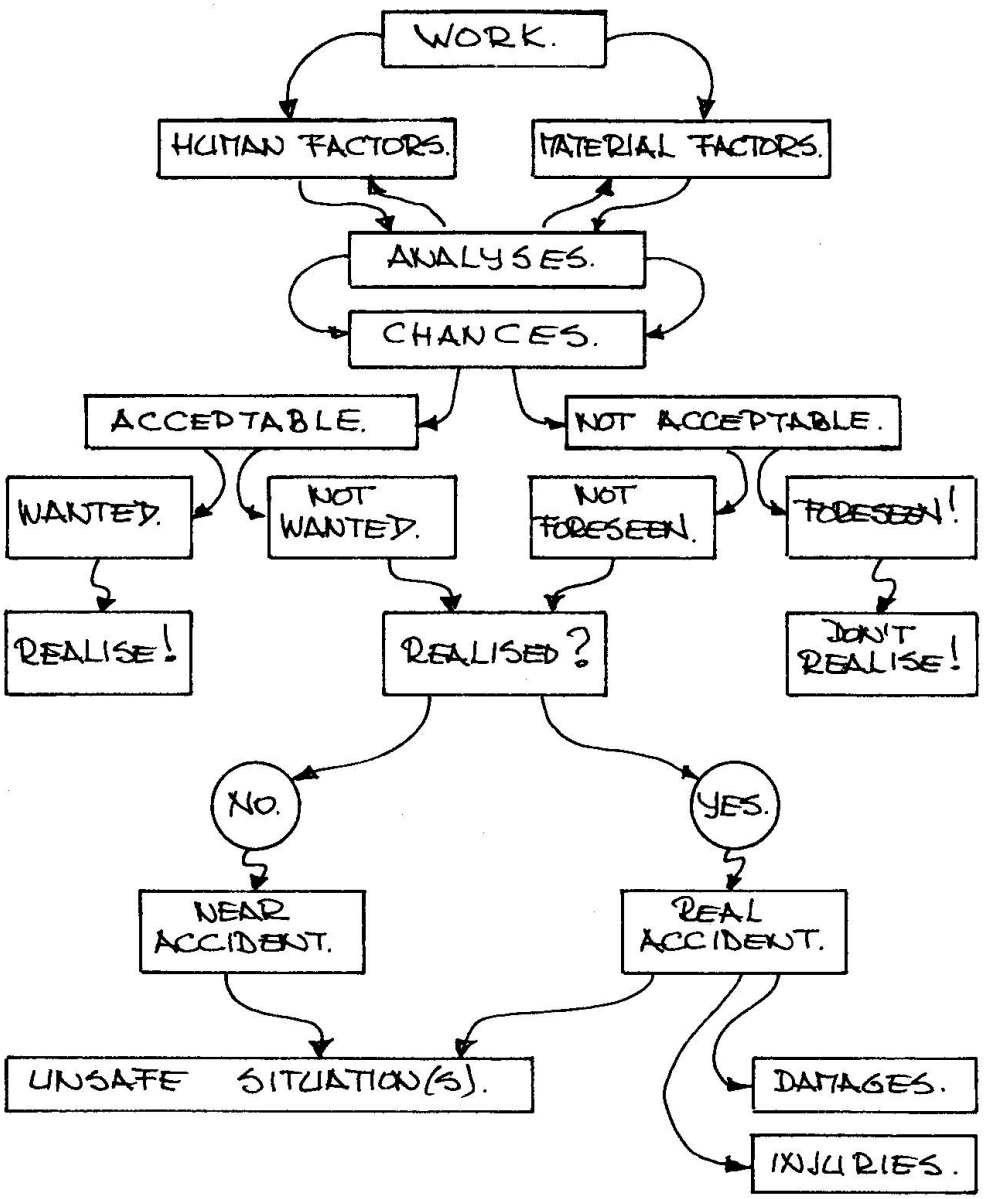

Fig. 13: Safety decision scheme

10. CONCLUSIONS

1. In the Construction Industry we have a big problem in the field of Health and Safety.

2. The number of accidents in the Construction Industry is relatively far more higher than in all other industries.

3. Accidents come form unsafe situations: the unsafe situations occur much more often than we can read from our accident-ratio.

4. Accident-ratio and Health-ratio should be related to each other; an equal definition of these ratio in different countries would give a possibility to compare.

5. Looking to these ratio figures is one thing: far more important is to find a feed back to prevention of accidents, to more safe situations.

6. Safety-Risk analysis give us a tool of management to more safe working conditions.

7. Safety planning and programming is a necessity for each construction company and for each construction site.

8. Safety measures should start at the scourses of possible unsafe actions and circumstances.

9. Safety and Health should be subject for more research and development programs.

10. Safety is the responsibility for all partners in the construction proces.