

**AN EXPERT SYSTEM FOR
MARINE UMBRELLA LIABILITY
INSURANCE UNDERWRITING**

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ABSTRACT

This paper describes three versions of an expert system for marine liability insurance underwriting. The first version, built on a PC, was the result of a series of knowledge engineering sessions with an underwriter of an insurance company. The prototype was accurate, but it asked too many marginally relevant questions, without regard to the time and business constraints of the user.

The second version was developed to address this concern. It initially asked only a subset of the relevant questions to arrive at a premium. If the premium was too high, the prototype attempted to reduce it by performing a sensitivity analysis on the results of the first round. This analysis was driven by meta-rules.

The third version was built on a lisp machine using a graphical expert system-building tool. The graphical approach and greater flexibility of the tool provided the user with an overview of the domain and permitted him to have more control over the data.

Any implementation of an expert system for marine liability insurance underwriting should incorporate the lessons learned from each of the three versions of the prototype. In addition, sensitivity analysis and a graphical interface could be useful for expert system domains other than insurance underwriting.

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An Expert System for Marine Umbrella Liability Insurance Underwriting

1.0 Introduction

This paper describes an application of expert systems to marine liability insurance underwriting. The domain expert was an officer of an insurance firm in New York City. Three versions of a prototype expert system were built, each to improve on the functionality of the previous one.

The three prototypes developed are referred to in this paper as Phases I, II, and III. Phase I consisted of knowledge engineering sessions with the domain expert to produce an initial prototype. This system, built for a PC using Insight 2, a PC expert system shell, chained through all of the rules gathered in the knowledge engineering sessions. The system, like most expert systems, was oriented solely toward producing the best possible answer. It asked every relevant question, whether important or unimportant. It did not consider the value of the user's time in selecting questions to ask.

The Phase I prototype successfully arrived at premiums similar to those of two human experts. The experts became impatient with the system, however, because it asked too many marginally relevant questions.

The Phase II prototype was developed to address this concern. It prioritized the rules and asked only the

most important ones to arrive at an initial premium. Then, if the premium was not acceptable (i.e., too high), the system would "chisel" the premium by asking more detailed questions in areas where it believed it could reduce the premium most effectively.

The Phase II system was more acceptable to the expert because it was able to mimic more closely the way he underwrites insurance policies. However, the capabilities of the system were limited because of the limitations inherent in the delivery vehicle, Insight 2.

The Phase III prototype was built on a lisp machine using an expert system-building tool, written in ART, under development by the Decision Support group at Coopers & Lybrand. The goal of the Phase III system was to test the effectiveness of the tool's graphical approach in helping the knowledge engineer build expert systems.

Since the tool was still under development when the Phase III system was being built, the experience of building this prototype influenced the design of some of the features of the tool. The graphical approach was very useful in developing the system. In addition, the tool was much more powerful than Insight, and it could smoothly produce features that were included in the Phase II prototype only with great effort.

A full implementation of this prototype would have to incorporate some outputs of each of the phases. The methods used to gather the information for the Phase I system would be useful in completing the knowledge

engineering for marine liability insurance umbrella policies. The result-directed sensitivity analysis implemented in Phase II would shape the system into a more useful tool, since it would behave more like an underwriter. Finally, the graphical representation implemented in Phase III of the system is more appealing to the user than is a questionnaire-like format. The user has a better idea of the context of the information needed to be entered, and he has more control over the inferencing.

2.0 Description of the Domain

This section describes the domain for the expert system. First it defines some terms used in insurance underwriting. (Complete descriptions of these and other insurance terms are given in [WEB84].) Then, it describes marine liability umbrella insurance and how an underwriter would write such a policy.

2.1 Definition of Terms

A person covered by an insurance policy is referred to as an assured. The insurance company is the insurer, and the person who writes the policy is the underwriter. The role of the underwriter is to assess the risk of granting insurance to the applicant. He makes this determination by assessing the exposures of the applicant. Exposures are facets of the applicant's business that are likely to result in a certain type of loss. The risk of the applicant is the

likelihood that he will experience a loss for a given exposure.

The underwriter gathers information about the applicant through a broker. The insurance broker attempts to negotiate the best price for an insurance policy on behalf of the applicant. The broker generally receives a commission on policies that are written through him.

An umbrella policy is one which covers more than one type of risk. Generally, umbrella policies are written only for large losses, and they are intended to take effect when underlying insurance is exhausted. Underlying insurance, in this case, would be insurance that is purchased for specific risks and for smaller losses.

There is generally a standard form for a liability umbrella, which has the standard wording of the policy. If exceptions are to be made to the general coverage that the umbrella offers, they are attached to the end of the policy. There are two types of exceptions: follow-form exclusions and endorsements. The only difference between the two is that follow-form exclusions exclude risks that the underlying insurance excludes, and endorsements exclude specified risks.

2.2 Marine Liability Umbrella Insurance

Marine liability umbrella insurance provides coverage for losses due to failure to fulfill a legal responsibility. The most common of these losses is due to

negligence on the part of the assured. The assureds for a marine liability insurance policy must have mostly waterfront risks. However, once his policy is written, the assured is also covered for the non-waterfront liability losses he may have.

To qualify for a marine liability umbrella, the applicant must first purchase underlying insurance for certain risks and for a specified limit. The umbrella is intended to cover the assured in the event of an unusually large loss.

For example, the applicant may be required to own auto, air, and general liability insurance, all with \$1 million limits, before he will be accepted for umbrella coverage. An umbrella with a \$5 million limit would then cover all losses in excess of the limits of the underlying insurance up to the limit of the umbrella, i.e., between \$1 million and \$5 million.

However, the assured may experience a loss that is not excluded by the umbrella, but for which he has no underlying insurance. In this situation, the umbrella policy would pay either the entire loss up to the umbrella limit, or the loss in excess of a specified amount (e.g., \$250,000), depending on the drop-down clause of the umbrella. It is the task of the underwriter to accurately assess the exposures of the applicant to avoid "dropping down" below the primary limits. Figure 1 is a graphical representation of this concept.

Marine Umbrella Liability Insurance

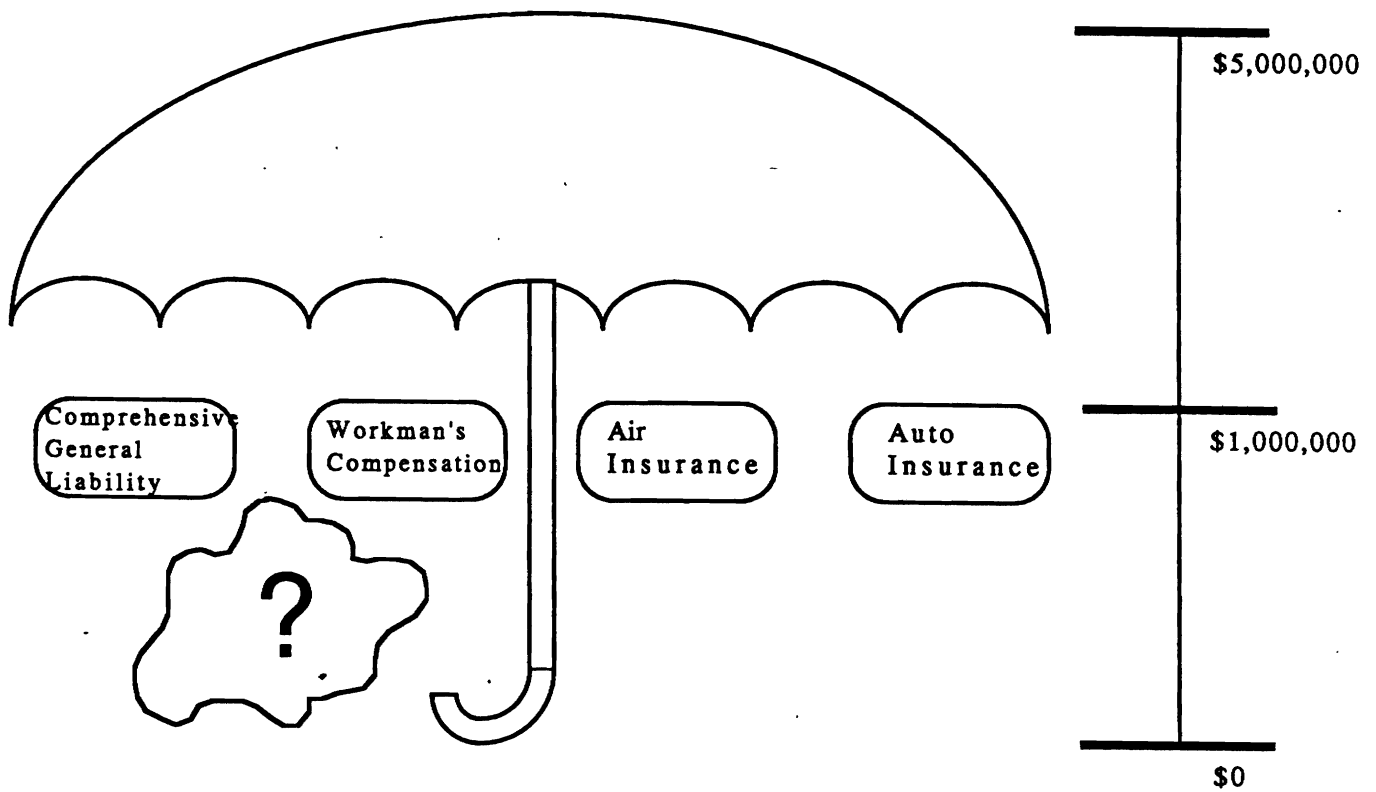


Figure 1

2.3 The Process of Underwriting

To underwrite umbrella policies, the underwriter gathers information about the applicant, the broker, the line of business of the applicant, and the competitive environment. He then weights the information to decide whether or not to accept the risk and at what price.

The broker supplies information about the applicant. In addition, the underwriter may know more about the applicant's loss record and business through other sources, such as previous policies written for the applicant. The underwriter's general relationship with the applicant, if one already exists, plays an important role in determining whether or not the underwriter is willing to accept the risk.

The underwriter's relationship with the broker is also important. The broker pre-screens the applicant whom he submits to the underwriter. An underwriter comes to expect a certain quality of applicant and of submission from each broker. He will be more willing to write a policy submitted by an honest broker whose clients have had few unexpected losses in the past.

The underwriter's knowledge about the line of business of the applicant can help him uncover risks. He draws on his knowledge about losses he covered for other applicants in a similar line of business. He is also aware of new developments in a given line of business. He comes to be wary of those developments which increase the exposure of

a type of applicant. For example, if an applicant stores large containers in his warehouse, the underwriter knows to ask what the containers hold or are intended to hold. This question would alert the underwriter to a potentially large pollution exposure or damage exposure from explosives.

Competition is also a factor in helping the underwriter price a policy. If there is a lot of competition, he will be willing to accept a lower return for his risk than if there were no competition. However, in a market where there is no competition, the underwriter begins to wonder whether his competitors know something he does not know about the risk for the market.

The process of underwriting, then, is to ask questions that will lead to areas of exposures of the applicant.

3.0 The Phase I Prototype

The Phase I prototype consisted of collecting the rules for the expert system. This section describes the four stages in developing the knowledge base for the system.

3.1 Select the Domain

The guidelines presented in [WAT86] for selecting the domain of an expert system were followed closely. Marine liability umbrella insurance was selected as the domain for reasons having to do with umbrella underwriting; the importance of umbrellas to the insurance company of the

underwriter, who was the domain expert in this case; and the fact that this was the specialty of the individual who served as the expert.

To underwrite a marine liability umbrella, a substantial amount of information must be collected and processed. Different information is needed for each different policy, depending on the characteristics of the applicants. An expert system built to consider these needs could ask all of the appropriate questions without "forgetting" any. In addition, it is possible to build an expert system for this application since the search space is reasonably sized.

Liability umbrellas involve large dollar amounts and therefore the potential losses are great. The cost of developing an expert system to write these policies would be justified by the careful consideration the system would give to applicants. These large potential losses are compounded by the fact that the insurance company of the domain expert in this case writes many umbrella policies. Therefore, the expert system would be useful for a large part of that company's business.

Liability umbrellas were chosen also because there existed an underwriter experienced in writing them who could articulate his thoughts and who was interested in the project. At the outset, the domain expert was not sanguine about the success of the system, but he was willing to invest the time to transfer his knowledge.

3.2 Define the Scope of the Prototype

The goal of the initial meetings with the expert was to gain an appreciation for the magnitude of the task of writing liability umbrella policies. The scope of the system could then be narrowed to one that was feasible within the time allotted and with the tools available. The importance of narrowing the search space is emphasized in [HAY83].

Figure 2 resulted from these preliminary meetings. Each of the areas of information that the underwriter collects to make his decision appear in the boxes. The ovals represent databases of information that the expert system should access. These databases would be updated by the system when a policy was approved by the underwriter. In addition, the base rates and factors that the system uses to arrive at a premium should be updated by the underwriter when necessary.

After considering the amount and impact of the information in each of the boxes in Figure 1, the scope of the expert system was narrowed. The umbrella policies that the system would write were those that required \$1 million of underlying insurance and carried a limit of \$5 million (called 5X1 umbrellas), covered only shipbuilders and vessel owners, and covered only those boats that fell in the class of smallcraft.

The restriction to 5X1 umbrellas was a key narrowing decision. All of the rules used by the expert change when the limits change. Since the most common combination of limits is \$5 million coverage in excess of \$1

Marine Liability Insurance Underwriting

Information Flow Diagram

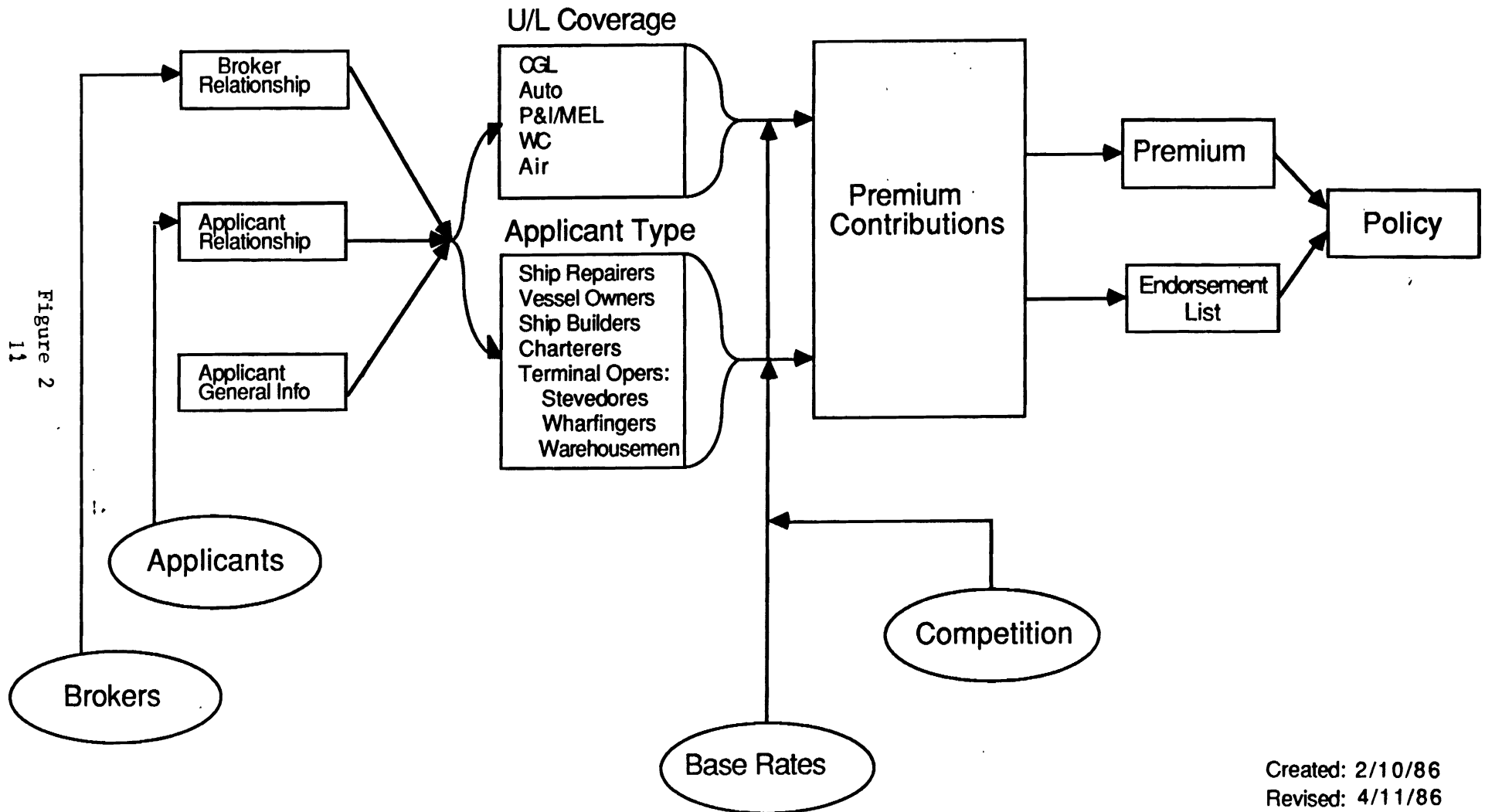


Figure 2
11

million underlying insurance, the 5X1 rules were incorporated into the expert system.

The expert also asks a different set of questions to applicants in each of the different lines of business. The most common of the applications received are for shipbuilders and vessel owners (and for shipbuilders who own vessels). Therefore, these two categories were selected from among the others in the line of business box of Figure 1.

Among vessel owners, there is a substantial divergence in risk depending on the size and type of their vessels. There is a uniform set of questions that must be asked of owners of small vessels (i.e., less than 2000 horsepower). However, for larger vessels such as blue water boats, jack-ups and semi-submersibles, there is no such uniform set. Applications from owners of these large boats are rarely received at the domain expert's insurance company, and therefore they were eliminated from the scope of this system.

3.3 Collect Rules

Once the scope of the system was defined, the underwriter was able to focus on specific aspects of underwriting these umbrella policies. Regular meetings with the expert were held to develop these rules. The method used to transfer this knowledge was through the spreadsheet described below, a page of which appears in Figure 3.

Market's Limit
CGH/SA policy
\$1M Limit
\$10,000/yr
2.25% of Receipts
ON Receipts
1-3M

Ship Repairs

Required Information

1. Common Questions

Effect of Information

\$0.75-\$1.00 of receipts is premium
losses x \$25,000

2. Detail of repairs:

- Vessel type
- Repair type

If vessel is commercial
THEN more chance of being assessed for loss of use damages.

If repair type is engine, power electric, propeller (motivation)
THEN more chance that something serious could go wrong after the repair.

If repair is structural
THEN not so great a chance of serious damage after repair

If repair is gas-freeing
THEN more chance of explosion, asphyxiation.

3. Red letter clause in effect? Amount of ciling?

If red letter clause in effect
THEN likely that SR will not get pay
sued in xs of amt of RLC
(if RLC is enforceable)

4. IS SR for the government?

If SR work is for the government
THEN less likely of a complaint
more likely enforceable RLC

5. % subcontracted (on premises)

6. Watercraft L-C-P Aircraft L-C-P

?? more non-employees
who could get injured
chance of overexposure

If L < \$1 million
THEN ?

If own water/aircraft - show-in if incidental
THEN add 40-50% of UL premium
20% \$5M

If C is a bad guy
THEN ?

If US Gulf
THEN larger chance of litigation

7. Location: Gulf v East Coast

Questions

In the past year? Trend?
Raise prem? Raise UL requirement?
How is type of loss described?
Does SR repair rigs? Insured?

into damaged is a function of magnitude of claim
100,000 details

POTENTIAL loss of use/business interruption
IN ADDITION to physical loss

Yes/Riskier

Why not so great risk if structural
welding easier than engine repair

loss of use

Chances are - repair of rigs would be at site on the rig itself
Shiprepairer would have to sign an indemnity agreement with vessel owner/operator agreeing to pay all claims for injury to shiprepairer employees (CGH - contractor)

No liability for this??
Ask if sub is covered?

Can these go on common info?
Any exceptions to 1 mil UL?

What affects this??

Limit
OWNED IS NONOWNED

What to do with the premium?

Raise prem or don't accept risk?
If raise, by how much? S/B reflected in U/L premiums
Locn is of repair site or of site of owned vessels?

Figure 3

less than B+ decline
B+ a small-might decline } Financial Status

Broker might volunteer otherwise assume NO

Whereas Repairs

bad news
good news

rates of vessel
show-in if incidental
OWNED & NONOWNED

Guide to - Part

Each box in the left half of Figure 2 had a corresponding spreadsheet. The expert could then work on a relatively isolated set of rules by directing his attention to one spreadsheet at a time.

The rows of each spreadsheet noted the general areas of questions the expert asked the broker when underwriting a policy. For each area, the first column attempted to structure the information in an IF-THEN-ELSE format, the second column held the relationship between the information and the premium, and the third column was reserved for any questions that surfaced while translating notes from the knowledge engineering sessions to the spreadsheet.

The spreadsheets were very effective in the knowledge acquisition phase both for the expert and for the knowledge engineer. The expert was able to focus his thoughts on a specific area of his work by directing his attention to one page of a spreadsheet at a time. He was able to expand his previous statements, which had been translated to the spreadsheet since the previous session. Also he was able to correct any errors that had been made in the translation.

From the perspective of the knowledge engineer, the spreadsheets were a way to make the transition from the expert's narrative to specific rules. The IF-THEN-ELSE column helped to locate gaps in the information collected from the expert. Also, the question column helped keep the

questions in context, since they appeared along with the information that prompted them. The process of structuring the information into the grid of the spreadsheet was an effective way of making a smooth transition from free-form dialogue to a rule-based system.

3.4 Computerizing the Prototype

To use the expert's time most efficiently, a portable computer was used to enable the knowledge engineer to bring the system to the desk of the underwriter. For this reason, the initial prototype was developed using a tool for the PC. The tool selected was Insight 2, a backward-chaining rule-based system for the PC, developed by Level Five Software, Inc.

The rules for the system were transcribed almost directly from the spreadsheets. The system asked all of the applicable questions that could possibly affect the premium amount in all of the following areas:

- o the applicant's circumstances
- o the underwriter's relationship with the applicant
- o the underwriter's relationship with the broker
- o the type and amount of underlying insurance the applicant owns

The underwriter can take many paths in calculating a premium. He has a preferred way of rating depending on the line of business of the applicant. For example, he usually derives a premium for an applicant who is a shiprepairer by multiplying a specified percentage by the

applicant's receipts. For vessel owners, this number is not appropriate, since his receipts do not accurately reflect the condition of his boats. The prototype's domain expert rates vessel owners by a method that incorporates a per-vessel rate with a certain percentage of the applicant's underlying insurance premiums.

Though he has a preferred rating scheme for each type of applicant, the expert also calculates a premium through other methods, to compare to his initial calculation. For example, he will multiply a certain rate by the shipboard-employee payroll of a vessel owner and compare the result to his earlier estimate.

The system follows the expert's process by calculating alternate premiums depending on the line of business of the applicant. For each group of questions, the system calculates a factor that would contribute either toward raising or lowering base percentages taken from a database of base rates. Certain factors such as those derived from competition, the broker relationship, and the applicant loss record are used in many different calculations. Others, such as the subcontractor factor, are used only to calculate one specific rate for a specific type of applicant. Figure 4 shows a rule that calculates the premium for shiprepairers based on a percentage of receipts.

Part of the process of calculating the premium is to verify the responses to the questions by comparing them to expected responses. This is an integral part of the

```

!
RULE #1 for calculating prelim percent of receipts
IF brkr fac is determined
AND asrd fac is determined
AND competition fac is determined
AND receipts credit is determined
AND exposures determined
AND ask for shiprepairer
THEN prelim receipts amt is determined
AND credits1 := comp fac + brkr fac + asrd fac + rec fac
AND credits2 := repair fac + vessel fac + locn fac
AND credits3 := govt fac + subk fac
AND credits := credits1 + credits2 + credits3
AND adj base := 0.0075 * (1- (credits / 100))
AND receipts amt := total receipts * adj base
!

```

Figure 4

underwriting process, since some of the calculations are based on premiums that were underwritten by another insurance company (i.e., the primary premiums). Therefore, the system has rules that calculate certain numbers and compare them to those input by the user. For example, the system expects the auto premium to reflect the auto exposures of the applicant. It therefore estimates what the auto premium should be with the information on auto exposures input to the system. If the result is very different from the auto premium input by the user, the system notes this fact, and uses its own number in future calculations. Figures 5 and 6 are screen displays of this occurrence.

The Phase I prototype's accuracy was acceptable to two experts who tested it against their own judgment. However, it had various limitations. First, the Insight tool does not permit string input and therefore there was no way to record the names of the applicant and the broker. This limitation was overcome for other questions by displaying all of the possible choices on the screen and allowing the user to choose one. However, this is not feasible for names of applicants and brokers.

The second limitation was that in order for the system to be useful over a number of years, there must be a way to update the databases (containing base rates) and the rules. As new exposures are discovered, the rules must be updated so that the system asks appropriate questions to uncover them.

Based on the number of vehicles the applicant owns or leases, the expected premium for the auto underlying insurance is
13000

Since the auto premium the applicant actually pays is much lower than this estimate, the auto exposure may actually be less than that indicated by the number of vehicles which the applicant owns or leases.

2 CONTINUE 3 REPORT

5 MENU

6 HELP

7 EXIT

Figure 5

The payroll amount of 20000
does not adequately compensate the 4
employees of the applicant.

The total payroll for shipboard employees has been
calculated to be 100000

Notify the broker of this difference, if you wish.

2 CONTINUE 3 REPORT

5 MENU

6 HELP

7 EXIT

Figure 6

Finally, the main limitation of the system was that it was too cumbersome to use. Its questioning routine was too lengthy since it asked all of the appropriate questions, though many of them may have affected the premium only marginally. They preferred a system that asked fewer questions initially, and then asked more questions only if the initial premium were too high.

4.0 The Phase II Prototype

The Phase II prototype was built to first ask just enough questions to derive a premium, and then to ask additional questions if the premium were not acceptable. This involved restructuring the rules of the Phase I system. This section describes why this prioritization was necessary, and how the approach was developed.

4.1 Motivation for Chiseling

In practice, the marine underwriter will ask only a subset of the relevant questions. Because information is very important in insurance underwriting, there must be very good reasons for not obtaining all the available information on the first pass.

The reasons have to do with the relationship between the underwriter and the broker. The underwriter depends on the broker for business. Therefore, he does not want to consume too much of the broker's time. His own time, too, is valuable.

There is another important reason. Over time, a

relationship of trust develops between broker and underwriter. The broker screens applicants before bringing them to the underwriter. The underwriter comes to trust the broker's judgment as to who is a good risk.

On the basis of his initial round of questions, the underwriter presents a proposed premium to the broker. Because of competitive pressures, the underwriter will offer the lowest premium he thinks is fair under the circumstances.

The broker may accept the premium. In that case, the deal is concluded and the necessary papers are drawn up.

Alternatively, the broker may reject the premium as completely unacceptable. In that case, there is no need to pursue the matter further.

Often, however, the broker will neither accept nor reject; instead, he will make a counter-offer. The counter-offer tells the underwriter that his initial suggested premium is close to an acceptable premium. The underwriter will then consider whether he can meet the lower premium and still make a profit.

The underwriter could do so if there are factors not yet considered that make the assured a better risk than the underwriter initially expected. To make this determination, the underwriter needs more information. Hence, he asks more questions, in an attempt to "chisel" away at the premium he initially suggested.

4.2 Development of Prototype Phase II

Phase II of the prototype implements this "chiseling" process. During the second and subsequent rounds of questioning, it continues to be important to ask the "best" questions first. The system uses meta-rules to guide it in its selection of questions to ask on the second and subsequent rounds.

This use of meta-rules is very similar to the approach documented in [DAV85]. The meta-rules are used specifically in "deciding which knowledge to invoke next in a situation where more than one chunk of knowledge may be applicable" [DAV85]. However, the meta-rules in the Phase II system guide this decision in a different way than do those of TEIRESIAS. While the TEIRESIAS meta-rules draw conclusions about the utility of rules in its system, the Phase II meta-rules actually invoke those rules which they deem most applicable.

The following paragraphs describe the way the meta-rules were developed and how they work.

4.2.1 Sensitivity Analysis using Meta-Rules

As was discussed earlier, the system's domain encompasses four general areas: line of business, applicant relationship, broker relationship, and underlying insurance. Within each area, there is a set of questions that should be asked on the first pass. These questions tend to be either general in nature or limited in scope. Questions that are

asked on subsequent passes either address specific details or widen the scope of the first round questions.

For example, on the first round, the underwriter may ask whether the relationship with the applicant is "good." When he is seeking to chisel, however, he has to know "how good." So, he may take the trouble to determine whether the applicant has suffered any losses in excess of \$1 million during the past five years. If not, the applicant looks better. If he needs to chisel further, he might investigate whether the applicant has suffered any losses in excess of \$1 million in the last ten years. If not, the applicant looks better still.

Similar deepening of questioning applies to the other three areas of inquiry. Instead of deepening, some "second round" questions may simply pursue other avenues of inquiry within the topic. The "line of business" questions, in particular, can become very involved.

The knowledge engineer's first step in implementing the Phase II prototype "chiseling" expert system was to identify the four general topics of inquiry: line of business, applicant relationship, broker relationship, and underlying insurance.

The second step was to identify "blocks" of questions within each topic, the answers to which can affect the results of the analysis. Each "block" enables the system to derive a value from which a sensitivity analysis could be performed. In the simple example above, each successive question about the applicant's loss record

constituted a "block."

The third step was to construct a matrix of blocks. Figure 7 presents the matrix of blocks used for the Phase II prototype. All the blocks in a given row of the matrix concern the same general topic of inquiry. Thus, for the Phase II prototype, there are five rows: two for "line of business," and one each for "applicant relationship," "broker relationship," and "underlying insurance."

The first column of the matrix in Figure 7 contains the types of questions which would be asked in each area on the first pass. The categories of questions in the second and third columns would be asked only if the initial premium was too high. For example, the underwriter might accept a lower margin on a policy for an applicant who provides the underwriter with a substantial amount of business unrelated to the umbrella insurance. Therefore, the amount of supporting business of the applicant is a secondary consideration for the underwriter, and becomes important only when the underwriter is "chiseling."

The fourth step in implementing the Phase II prototype was to select an order in which the blocks should be presented to the user. This ordering is implemented with a set of meta-rules, that govern the order in which the blocks of substantive rules will fire. One approach would be to exhaust all questions about "line of business" first. Another approach would be to rotate questions from each of the five groups.

<u>AREAS</u>	<u>BLOCKS</u>		
BROKER INFORMATION	name	supporting business	
	loss record		
APPLICANT INFORMATION	name	supporting business	
	loss record		
	location	renewal info.	
	line of bus.		
	descrip of bus.		
	receipts		
	payroll		
	employees		
PRIMARY INSURANCE	limit	calc. for accepting lower limit	
	premium		
	carrier		
SHIP REPAIRERS	repair type	subcontracting	govt. work
	vessel type	cargo coverage	Red Letter Clause
	add'l insurance		
VESSEL OWNERS	# boats by type	use of boats	vessel surveys
	hazardous cargo	hold-harmless agreement	
	cargo ownership		
	crew per vessel		
	vessel condition		
	add'l insurance		

Figure 7

4.2.2 Driving the Process Using "Meta-meta-rules"

In order to improve the performance of the system, several alternate orderings (sets of meta-rules) were established. The ordering used (the set of meta-rules invoked) would depend on which was most likely to produce results in the given situation.

For example, if the initial round of calculations arrived at the expert's baseline minimum allowable premium, then the group of meta-rules that try to reduce the allowable premium below the baseline would fire. Alternatively, if the initially-suggested premium were above the minimum allowable premium, then the system would pursue another line of more detailed questioning to chisel the premium lower.

Results established in the first round of questioning determine which meta-rules will be invoked. This is accomplished by a set of rules, which may be dubbed "meta-meta-rules." These rules drive the sensitivity analysis.

4.2.3 Sample Chiseling Rules

Figure 8 presents a sample sequence of meta-rules. The meta-meta-rules are embedded in the inference engine and need not be explicitly coded, since Insight executes the meta-rules in the order in which they appear in the knowledge base. The meta-rule entitled "RULE #6 for chiseling" is the implementation of the chiseling example given in Section 4.2.1.


```

!      A. Rules which check if target is reached
!
RULE for checking the target premium
IF check target
AND target is met
THEN chiseling path completed
AND DISPLAY target has been reached
!
RULE for checking target
IF premium <= target premium
THEN target is met
ELSE NOT target is met
AND CYCLE
!
!      B. Determine chiseling paths
!
RULE #1 for chiseling
IF premium = rol
AND NOT rol is reached
AND rol is determined
AND premium := rol
THEN rol is reached
AND check target
!
RULE #2 for chiseling
IF premium = rol
AND NOT renewal is reached
AND renewal is determined
THEN renewal is reached
AND check target
!
RULE #3 for chiseling
IF ask for shiprepairer
AND NOT govt fac is reached
AND govt fac is determined
AND prelim receipts amt is determined
THEN govt fac is reached
AND premium := receipts quote
AND check target
!
RULE #4 for chiseling
IF ask for shiprepairer
AND NOT subk fac is reached
AND subk fac is determined
AND prelim receipts amt is determined
THEN subk fac is reached
AND premium := receipts quote
AND check target
!
RULE #5 for chiseling
IF ask for vessel owner
AND NOT hh is reached
AND hold harmless agreement is determined
AND prelim receipts amt is determined
THEN hh is reached
AND premium := receipts quote
AND check target
!
RULE #6 for chiseling
IF NOT sup bus is reached
AND supporting business of asrd is determined

```

Figure 8

After each block of questions is asked, affected variables are incremented or decremented, and the premium is recomputed. If the combined decrements to the premium are sufficient to bring the suggested premium within range, the user is presented with the new premium and with all the areas where chiseling was done.

This is accomplished by the rule for checking the target, in Figure 8. This rule relies on Insight's CYCLE feature. The keyword CYCLE indicates to the inference engine that it should go to the top of the knowledge base, reset all of the variables named in the FORGET statement to unknown (see Appendix A for this statement), and continue trying to satisfy the goal. As a result, the next rule to fire will be a subsequent meta-rule. The condition "X is reached" in each meta-rule insures that the rule fires only once.

If all of the chiseled variables are approved, the system is done. If some or none are approved, the underwriter is on his own. A fairly straightforward enhancement would allow the system to continue chiseling if the results were only partially approved.

5.0 The Phase III Prototype

The Phase II prototype greatly improved upon the Phase I system's questioning routine. The Phase III system was built to improve the user interface for the expert system and to experiment with both a more powerful environment for the system and a graphical approach to

building expert systems.

5.1 The Tool for the Phase III Prototype

The tool used for the Phase III system is being developed by the Insurance AI group at the accounting firm of Coopers & Lybrand (C&L). [FRI86] describes the design of the tool in detail. At the time the Phase III system was implemented, the tool had not been completed. The tool and the prototype were therefore developed to complement one another; the needs of the prototype were incorporated as features of the tool, and the capabilities of the tool permitted additional features for the prototype.

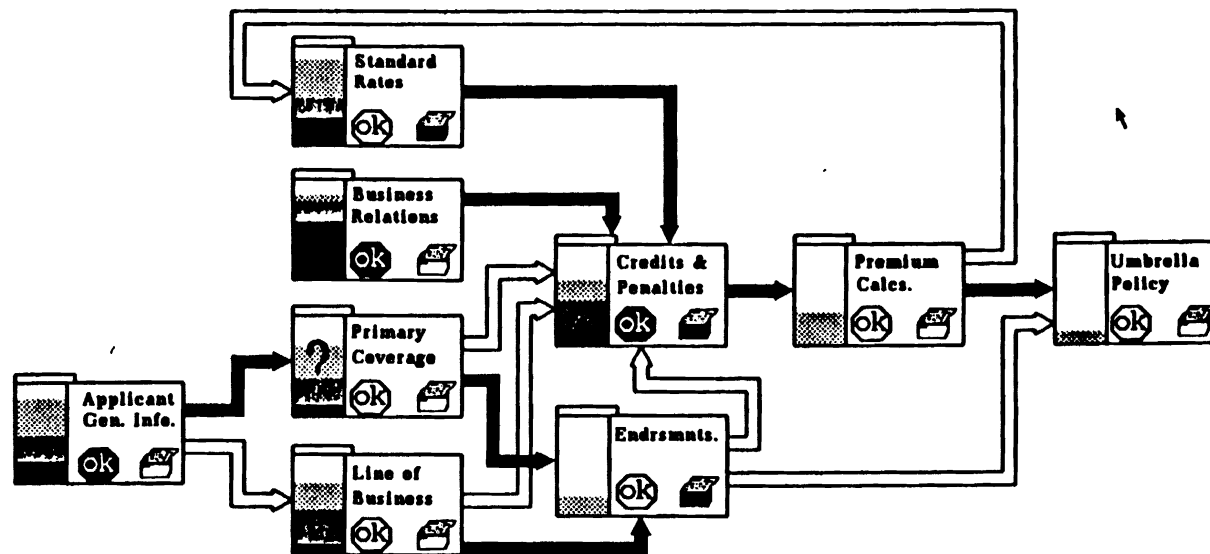
The C&L tool uses a graphical user interface for the expert system. The desirability of a graphical model for solving business problems has been documented in [CLE85]. Rather than popping questions on the screen one at a time, the interface with the user is with drawers, folders, and forms. The user selects a drawer that contains information about a given request for insurance. Figure 9 is an example of a drawer. Figures 10 and 11 show the contents of a folder and a form of this drawer.

Within a drawer are numerous folders which group related pieces of information, much like folders in a filing cabinet. The folders are connected by arrows, which indicate the inter-folder relationships. Each folder has any number of forms. The form contains slots for input information and to hold information inferred by the system.

CASES
 NEW CASE
 Fantasy Island
 Hal's Cruise Line
 Long Island Yacht
 NY Port Authority
 Westbury Marine

MARINE UMBRELLA LIABILITY INSURANCE UNDERWRITER

Long Island Yacht



Click on folder title to open folder. Click on a data meter to start inference.

Coopers & Lybrand

QUALITY OF INFORMATION: - certain - probable - guessed

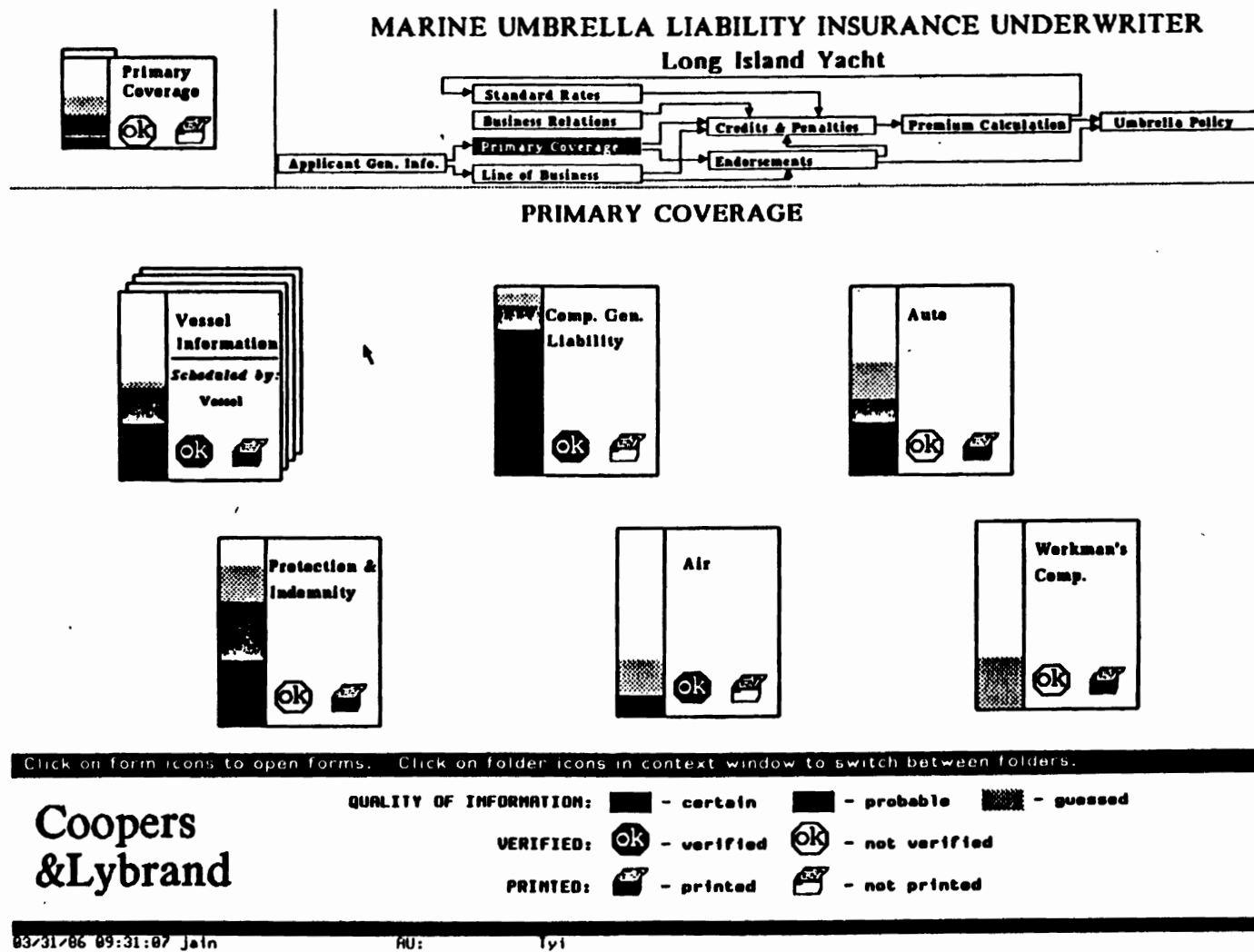
VERIFIED: - verified - not verified

PRINTED: - printed - not printed

INFERENCE: - ready to fire - not ready

03/31/86 09:25:23 Jain AU: (no window)

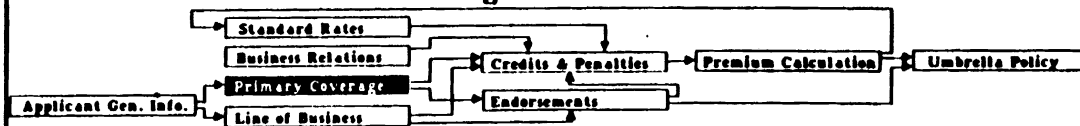
Figure 9



SCHEDULES
NEW SCHEDULE
 American Dream
 Encore Girl
 Marblehead Princess
 Russian Dream
 Yankee

MARINE UMBRELLA LIABILITY INSURANCE UNDERWRITER

Long Island Yacht



Vessel Information Form

Vessel: Marblehead Princess



Vessel Type:

Value:

Location:

Cargo:

Number of Crew:

Age:

Base Amount for Boat:

Base Amount for Crew:

Base Amount for Location:

Boat Contribution:

Crew Contribution:

Location Factor:

Premium Contribution:

**Coopers
&Lybrand**

QUALITY OF INFORMATION: - certain - probable - guessed

VERIFIED: - verified - not verified

PRINTED: - printed - not printed

FIELD LABELS: label - intended for entry
 label - intended for inference

FIELD VALUES: value - source as intended
 value - inference intended but entered

03/31/86 13:03:27 Jain

AU:

Typ

Figure 11

The relationships between the data items in the forms are represented in rules. The two main types of relationships that can be represented in rules are inter-folder and intra-folder relationships. The rules are written in ART, a language developed by Inference Corporation, since the C&L tool itself is written in ART.

An inter-folder rule is shown in Figure 12. The user can control whether or not inter-folder rules fire by selecting with the mouse a folder that is connected by connector-1. For this reason, the rule has a ready-to-fire component and a firing component. The firing component will execute only after the user has selected the destination folder with the mouse.

Intra-folder rules appear in Figure 13. These rules are simpler than the inter-folder rules since they fire as soon as their preconditions are met. They can represent either inter-form relationships within a folder, or intra-form relationships.

The amount of data entered in each folder and in each form is indicated by the meter on the left part of every folder and form icon. The meter is color-coded, so that the user knows the origin of the information represented by the icon. The colors indicate that the information was entered by the user, inferred by the system, or obtained by default. Absence of color in the meter indicates that there is missing information.

```

(defrule receipts-based-prem-1-ready-to-fire
  (logical (shiprepairer applicant ("X" ?s-src))
    (receipts applicant (?rec ?rec-src))
    (sum-reln-factors calculations (?srfac ?srfac-src))
    (receipts-credit calculations (?rc ?rc-src))
    (repair-fac calculations (?rf ?rf-src))
    (vessel-fac calculations (?vf ?vf-src))
    (location-fac calculations (?lf ?lf-src))
    (govt-fac calculations (?gf ?gf-src))
    (subk-fac calculations (?sf ?sf-src))
    (pct-of-receipts standard-rates (?por ?por-src)))
  =>
  (assert (ready-to-fire (connector-1 connector-13) receipts-based-prem-1)))

(defrule receipts-based-prem-1-firing
  "calculation of premium based on receipts for shiprepairers"
  (logical (shiprepairer applicant ("X" ?s-src))
    (receipts applicant (?rec ?rec-src))
    (sum-reln-factors calculations (?srfac ?srfac-src))
    (receipts-credit calculations (?rc ?rc-src))
    (repair-fac calculations (?rf ?rf-src))
    (vessel-fac calculations (?vf ?vf-src))
    (location-fac calculations (?lf ?lf-src))
    (govt-fac calculations (?gf ?gf-src))
    (subk-fac calculations (?sf ?sf-src))
    (pct-of-receipts standard-rates (?por ?por-src)))
  ?fact <- (ready-to-fire (connector-1 connector-13) receipts-based-prem-1)
  (inter-folder-connector connector-1 | connector-13)
  =>
  (assert (receipts-based-prem calculations
    (=?rec * ?por * (1 - (+ ?srfac ?rc ?rf ?vf ?lf ?gf ?sf))))
    =(min-src ?rec ?por ?srfac-src ?rc ?rf ?vf ?lf ?gf ?sf))))
  (retract ?fact))

```

Figure 12


```

; translating competition (betw 1 and 10) to a percent (betw -25 and 33)

(defrule convert-competition-1
  (logical (competition standard-rates (?comp & : (comp < 5) ?src-comp)))
  =>
  (assert (comp-fac standard-rates
    (= (25 - (?comp * 5)) =(min-src ?src-comp)))
    (renewal-comp-fac standard-rates (0.333 =(min-src ?src-comp)))
    (renewal-credit standard-rates (0.15 =(min-src ?src-comp)))))

(defrule convert-competition-2
  (logical (competition standard-rates (?comp & : (comp > 5) ?src-comp)))
  =>
  (assert (comp-fac standard-rates
    (= (-7 * (?comp - 5)) =(min-src ?src-comp)))
    (renewal-comp-fac standard-rates (-0.333 =(min-src ?src-comp)))
    (renewal-credit standard-rates (-0.25 =(min-src ?src-comp)))))

(defrule convert-competition-3
  (logical (competition standard-rates (5 ?src-comp)))
  =>
  (assert (comp-fac standard-rates (0 =(min-src ?src-comp)))
    (renewal-comp-fac standard-rates (0 =(min-src ?src-comp)))
    (renewal-credit standard-rates (-0.25 =(min-src ?src-comp)))))

```

Figure 13

5.2 Development of the Phase III Prototype

In order to build a prototype on such a system, it is necessary to separate the information into folders and forms. Whereas in the prototypes developed on Insight 2 all of the rules were lumped together in the knowledge base in any order, the C&L tool requires the information to be classified according to stages in the process of determining the final premium.

For example, the folders on the left-hand side of Figure 9 contain forms that are mostly for data input. Those on the right-hand side of Figure 9 contain forms that have mostly inferenced data. The inter-folder rules accomplish this translation of information from the left to the right sides of the screen. The insurance policy, the rightmost folder on the screen, is the result of the efforts of all of the rest of the folders in the system.

The configuration of the folders for the Phase III system is strikingly similar to the initial information flow diagram developed in Phase I. This similarity can be seen by comparing Figures 2 and 9. The items in the boxes of the information flow diagram are forms in the Phase III prototype. Therefore, the folder and form approach of the C&L tool is a good medium for expert system development, at least for the case at hand.

After the skeleton for the Phase III system was developed, i.e., the folders, forms, and inter-folder relationships were derived, the rules of the Phase I

prototype were translated to ART rules. This was a relatively simple process, since all of the knowledge acquisition had been completed. The relationship between rules in the two systems can be seen by comparing Figures 4 and 12.

In addition, rules had to be written for data entry editing. For example, if the user was permitted to select only one of several items on a form, rules had to insure that he did not select more than one. These rules were also straightforward, since once a fact is retracted, ART has the ability to chase after all conclusions that depended on that fact and retract them also.

5.3 Performance of the Phase III Prototype

With the graphical approach of the C&L tool, the user is able to see the entire problem laid out in front of him. For the previous prototypes, the user answered one question at a time and did not know how far along he was in reaching his goal, or even what was the general context of the questions. In the Phase III system, he can see all other related fields on a form when he enters data, and he knows where he is in the entire system by looking at a window at the top of the screen, called the context window, which displays a miniature replica of the configurations of the folders.

Another advantage of the Phase III system over the previous ones is that more options are open to the knowledge engineer using the C&L tool. It would be possible, using

this tool, to implement the enhancement described above to allow the user to reject some but not all "chiseled" variables. Also, the C&L tool permits string input, and therefore the names of the applicant and the broker can be entered into the system and stored.

The C&L tool also has greater flexibility for the user to enter information, since he is permitted to override certain system-inferred fields on the forms. For example, the system has a form called Schedule of Vessels. This form is really a series of forms, one for each vessel that the applicant owns. Separately, on the Vessel Owner form, there are fields labeled Summary of Schedule of Vessels. Rather than enter information about each vessel in the schedule of vessels, the user can input the summary fields directly. This is advantageous from the perspective of the user since he frequently receives the information from the broker in the form of a summary, and he would like to be able to run a "rough guess" on the system with that summary information.

The graphical interface has its drawbacks, too. Because the user can enter information in any order on any form, the advantages of chiseling realized in the Phase II system cannot be directly implemented in the C&L tool. In addition, if answers to questions eliminate certain data fields from being applicable, those fields still appear on the forms. Both these drawbacks can be overcome, however.

To prevent the user from entering non-applicable data, rules were written to fill those fields on the forms

with N/A. Since every non-applicable field will be filled in, the user will see a full reading on the data meter corresponding to the form containing these fields. Therefore the non-applicable areas will not appear as missing information. An improvement over this method would be for the tool to prevent the non-applicable fields from being displayed.

In order to convey to the user the priorities among data items established in Phase II, to implement chiseling, fields on the forms could be color coded, or highlighted. Rules could be written which would control those fields that would be highlighted at any given point in time.

6.0 Conclusions

Sensitivity analysis in expert systems could be applicable to domains other than insurance underwriting. [CLE85] describes a method for sensitivity analysis on graphical models for any business domain. In addition, the C&L tool, in its full implementation as described in [FRI86], will be able to perform sensitivity analysis for any type of financial expert system.

Insurance underwriting is a fertile field for expert system applications. A survey conducted by Coopers & Lybrand of the top 100 insurance firms in New York [COO86] indicates that there is substantial interest among those firms in developing expert systems. In addition, Syntelligence, Inc. has developed an Underwriting Advisor,

intended for use by field underwriters in the areas of commercial property, workers' compensation, inland marine general liability, and commercial auto insurance [EXP86].

The prototypes described in this paper were based on ocean marine liability insurance. Since standard rates do not exist for ocean marine liability umbrella policies, the underwriter of these umbrellas depends heavily on his judgement and experience. It is therefore difficult to develop a generic expert system for marine liability umbrella insurance that could be used by more than one insurance company.

Any subsequent implementation of an expert system for marine liability insurance underwriting should incorporate the lessons learned in each of the three Phases of the prototype. The knowledge acquisition methods (e.g., the spreadsheet approach) of the Phase I prototype could be used to gather the remaining information in the domain, to make the system a complete one for the application. The result-directed sensitivity analysis of the second phase of the prototype would enable the final system to perform like the underwriters. The user interface of the Phase III prototype is desirable, as is its flexibility and the increased amount of control the user has over the inferencing process.

The existing prototypes cover only a subset of the domain of marine liability umbrellas, since the scope was narrowed in the Phase I knowledge acquisition stage. A complete system would include all lines of business, rather

than just ship repairers and vessel owners. It would also consider combinations of insurance limits other than 5X1.

The chiseling rules of the Phase II system are only a subset of the possible ones. The prototype modeled only the simple relationships between information collected on the "first pass" and the chiseling rules. Additional chiseling rules could, for example, trade off premium for coverage by excluding certain risks to lower the premium.

The graphical approach of the Phase III system permitted the user to get an idea of the context of the information he was supplying. The entire system is represented by icons which appear on the screen in an intuitively appealing format for the underwriter.

Any of the prototypes, in their current state, could be used effectively as a training tool for new underwriters. Currently, the trainee sits with the underwriter for many months trying to learn the business by watching. The prototypes would teach the trainee the appropriate questions to ask in a wider variety of hypothetical situations than he would see during his apprenticeship with the underwriter.

In order for an implementation version to be used in practice by the underwriter, it must include an easy way to update the rules, the base rates, and the loss records of both applicants and brokers. The prototypes are not yet field-ready, but they do represent a solid start toward a deployable expert system for marine liability insurance underwriting.

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APPENDIX A

The Phase II Knowledge Base

```

TITLE      MARINE LIABILITY UMBRELLA INSURANCE UNDERWRITER
!
!
!
!
INIT dummy
! first pass value for rate-on-line is $10,000
INIT rol = 10000
INIT min rol = 7500
! competition is set to a level of 8
INIT competition = 8
INIT max vessel value = 0
INIT per vessel quote = 0
INIT barge prem = 0
INIT tug prem = 0
INIT cs prem = 0
! factors for round 2
INIT govt fac = 0
INIT subk fac = 0
FORGET prelim receipts amt is determined
AND check target
AND target is met
THRESHOLD = 60
MULTI line of business
AND special cargo
AND cs special cargo
CONFIDENCE OFF
GOALSELECT OFF
SUPPRESS ALL
!
1. rates are determined
   1.1 chiseling is done
   1.2 chiseling failed
!
! I. CHISELING RULES
!
RULE #1 to control chiseling
IF alternative suggestion exists
AND target premium < premium * 0.75
THEN chiseling is done
AND DISPLAY target is too low
!
RULE #2 to control chiseling
IF alternative suggestion exists
AND target premium > premium
THEN chiseling is done
AND DISPLAY make sure higher rate is not a trap
!
! in case he really didn't have an alt. suggestion
!
RULE #3 to control chiseling
IF alternative suggestion exists
AND target premium = premium
THEN chiseling is done
!
RULE #4 to control chiseling (real chiseling to do here)
IF alternative suggestion exists
AND target premium >= premium * 0.75
AND target premium < premium
AND chiseling checks initialized
AND chiseling path completed

```

```

THEN chiseling is done
!
RULE #6 to control chiseling
IF dummy
THEN chiseling failed
AND DISPLAY target cannot be reached
!
!   The CYCLE is in this rule so that the FORGET
!   statement can become active
!
RULE for initializing chiseling checks
IF dummy
THEN chiseling checks initialized
AND NOT rol is reached
AND NOT renewal is reached
AND NOT govt fac is reached
AND NOT subk fac is reached
AND NOT hh is reached
AND NOT sup bus is reached
AND CYCLE
!
!   A. Rules which check if target is reached
!
RULE for checking the target premium
IF check target
AND target is met
THEN chiseling path completed
AND DISPLAY target has been reached
!
RULE for checking target
IF premium <= target premium
THEN target is met
ELSE NOT target is met
AND CYCLE
!
!   B. Determine chiseling paths
!   the statement "X is reached" is initially set
!   to false. After the corresp. chiseling rule is
!   tried, it is set to true. Subsequent chiseling
!   cycles will not retry the rule.
!
RULE #1 for chiseling
IF premium = rol
AND NOT rol is reached
AND rol is determined
AND premium := rol
THEN rol is reached
AND check target
!
RULE #2 for chiseling
IF premium = rol
AND NOT renewal is reached
AND renewal is determined
THEN renewal is reached
AND check target
!
RULE #3 for chiseling
IF ask for shiprepairer
AND NOT govt fac is reached
AND govt fac is determined
AND prelim receipts amt is determined
THEN govt fac is reached

```

```

IF ask for shiprepairer
AND NOT subk fac is reached
AND subk fac is determined
AND prelim receipts amt is determined
THEN subk fac is reached
AND premium := receipts quote
AND check target
!
RULE #5 for chiseling
IF ask for vessel owner
AND NOT hh is reached
AND hold harmless agreement is determined
AND prelim receipts amt is determined
THEN hh is reached
AND premium := receipts quote
AND check target
!
RULE #6 for chiseling
IF NOT sup bus is reached
AND supporting business of asrd is determined
THEN sup bus is reached
AND premium := premium * (1 - (asrd business fac / 100))
AND check target
!
! II. FIRST PASS: CALCULATE PREMIUMS
!
!   A. Shiprepairer:
!       Mainly care about
!       premium based on percent of receipts.
!
RULE #1 for goal (shiprepairer)
IF brkr fac is determined
AND applicant information collected
AND competition fac is determined
AND exposures determined
AND ask for shiprepairer
AND NOT ask for vessel owner
AND receipts quote is determined
THEN rates are determined
AND excess quote := CGL quote + auto quote + sr quote
AND premium := receipts quote
AND DISPLAY sr final results
!
!   B. Vessel Owners:
!       Use premium based on payroll to compare to
!       main premium calculation, which is xs ul + P&I
!
RULE #2 for goal (vessel owners)
IF brkr fac is determined
AND applicant information collected

```

```

AND competition fac is determined
AND exposures determined
AND ask for vessel owner
AND NOT ask for shiprepairer
AND payroll quote is determined
THEN rates are determined
AND excess quote:= CGL quote + auto quote + per vessel quote
AND premium := excess quote
AND DISPLAY vo final results
!
!   C. Shiprepairer who also owns vessels
!       Premium based on payroll is reported separately,
!       but excess quote reflects exposures of both
!
RULE #3 for goal (shiprepairer and vessel owner)
IF brkr fac is determined
AND applicant information collected
AND competition fac is determined
AND exposures determined
AND ask for shiprepairer
AND ask for vessel owner
AND payroll quote is determined
AND receipts quote is determined
THEN rates are determined
AND excess quotel := CGL quote + auto quote
AND excess quote2 := sr quote + per vessel quote
AND excess quote := excess quotel + excess quote2
AND premium := receipts quote
AND DISPLAY vo final results
!
! II. BROKER RELATIONSHIP
!
RULE for determining broker factor
IF brkr reln is determined
THEN brkr fac is determined
AND brkr fac := brkr reln fac
!
!   A. Loss Record
!
! For testing purposes, broker #1 is good,
! #2 is bad, and #3 is indifferent
!
RULE #1 to determine reln with brkr
IF brkr IS broker #1
THEN brkr reln is determined
AND brkr reln fac := 5
!
RULE #2 to determine reln with brkr
IF brkr IS broker #2
THEN brkr reln is determined
AND brkr reln fac := -10
!
RULE #3 to determine reln with brkr
IF brkr IS broker #3
THEN brkr reln is determined
AND brkr reln fac := 0
!
RULE #4 to determine reln with brkr
IF brkr IS other broker
AND broker reln asked

```

```

THEN brkr reln is determined
!
!   If the broker is not known, then ask for
!   the broker relationship to be input.
!   (Should also save the info to the data base)
!
RULE #1 to ask for reln to be input
IF brkr reln IS good
THEN broker reln asked
AND brkr reln fac := 5
!
RULE #2 to ask for reln to be input
IF brkr reln IS bad
THEN broker reln asked
AND brkr reln fac := -10
!
RULE #3 to ask for reln to be input
IF brkr reln IS indifferent
THEN broker reln asked
AND brkr reln fac := 0
!
!       B. Supporting Business
!       This is not asked on the first pass
!
!   For testing purposes, broker #1 is substantial,
!   #2 is some, and #3 is none.
!
RULE #1 for supporting business of brkr
IF brkr IS broker #1
THEN supporting business of brkr is determined
AND brkr business fac := 0
!
RULE #2 for supporting business of brkr
IF brkr IS broker #2
THEN supporting business of brkr is determined
AND brkr business fac := -5
!
RULE #3 for supporting business of brkr
IF brkr IS broker #3
THEN supporting business of brkr is determined
AND brkr business fac := -10
!
RULE #4 for supporting business of brkr
IF brkr IS other broker
AND broker sup bus asked
THEN supporting business of brkr is determined
!
!   If the broker is not known, then ask for the amount
!   of supporting business from the broker to be input.
!   (Should also save the info to the data base)
!
RULE #1 for asking for supporting business input
IF brkr sup bus IS substantial
THEN brkr sup bus asked
AND brkr business fac := 0
!
RULE #2 for asking for supporting business input
IF brkr sup bus IS little
THEN brkr sup bus asked
AND brkr business fac := -5

```

```

!
RULE #3 for asking for supporting business input
IF brkr sup bus IS none
THEN brkr sup bus asked
AND brkr business fac := -10
!
! III. APPLICANT INFORMATION
!
RULE for collecting applicant information
IF line of business is determined
AND asrd loss rec is determined
AND locn is determined
THEN applicant information collected
!
!   A. Line of Business
!
RULE #1 for line of business
IF line of business IS shiprepairer
THEN ask for shiprepairer
AND line of business is determined
!
RULE #2 for line of business
IF line of business IS vessel owner
THEN ask for vessel owner
AND line of business is determined
!
!   B. Applicant Loss Record
!
! Should be able to look up applicant in the
! data base but cannot do so because there is no
! way to enter the applicant's name, and there are
! too many to choose from.
!
RULE #1 to determine loss record of applicant (clean)
IF avg claim in excess of $10,000 < 25000
THEN asrd loss rec is determined
AND asrd fac := 10
!
RULE #2 to determine reln with asrd (good)
IF ask for shiprepairer
AND receipts credit is determined
AND avg claim in excess of $10,000 < 0.5 * total receipts
THEN asrd loss rec is determined
AND asrd fac := 5
!
! In rule #3, should really ask for details of losses
! in excess of $100,000: Year, amt, descrip of loss, has
! the problem which caused the loss been remedied.
!
RULE #3 to determine reln with asrd (bad)
IF ask for shiprepairer
AND avg claim in excess of $10,000 >= 0.5 * total receipts
THEN asrd loss rec is determined
AND asrd fac := -10
!
RULE #4 to determine reln with asrd (bad)
IF ask for vessel owner
AND avg claim in excess of $10,000 < 100000
THEN asrd loss rec is determined
AND asrd fac := 5

```

```

!
RULE #5 to determine reln with asrd (bad)
IF ask for vessel owner
AND avg claim in excess of $10,000 >= 100000
THEN asrd loss rec is determined
AND asrd fac := -10
!
!   C. Location of Applicant
!
RULE #1 for location factor
IF location IS U.S. Gulf
THEN locn is determined
AND locn fac := -10
AND location is gulf
!
RULE #2 for location factor
IF location IS East Coast
THEN locn is determined
AND locn fac := 0
AND location is east coast
!
RULE #3 for location factor
IF location IS other
THEN locn is determined
AND locn fac := 0
AND location is other
!
!   A. Previous policy info: (asked on second round)
!
!       1. Premium
!
RULE for determining previous policy premium
IF previous bumbershoot premium is known
THEN prev prem is determined
AND prev prem := previous bumbershoot premium
ELSE prev prem is determined
AND prev prem := 0
!
!       2. Loss Record
!
RULE #1 for renewal loss record
IF renewal rec IS clean
THEN renewal loss record is determined
AND renewal fac := 10
AND renewal record is clean
!
RULE #2 for renewal loss record
IF renewal rec IS good
THEN renewal loss record is determined
AND renewal fac := 5
!
RULE #3 for renewal loss record
IF renewal rec IS bad
THEN renewal loss record is determined
AND renewal fac := -10
!
RULE #4 for renewal loss record
IF renewal rec IS indifferent
THEN renewal loss record is determined
AND renewal fac := 0

```



```

!
!       3. Number of Years of Renewal
!
RULE #1 for renewal policy questions
IF renewal policy
AND renewal loss record is determined
THEN renewal policy is determined
AND num years := number of years of renewal
!
RULE #2 for renewal policy questions
IF NOT renewal policy
THEN renewal policy is determined
AND num years := 0
AND renewal comp fac := 0
!
!       4. Renewal Credits
!       Note: renewal comp fac is > 0 for comp < 5
!             and < 0 for comp > 5. These rules temper the
!             increase or decrease given to a renewing client
!
!       Also note that renewal comp fac is calculated
!             in Section V.
!
RULE #1 for renewal credits
IF renewal policy is determined
AND prev prem is determined
AND competition fac is determined
AND competition < 5
THEN prevprem quote is determined
AND prevprem quote:=prev prem*0.85+(0.15* renewal comp fac)
!
RULE #2 for renewal credits
IF renewal policy is determined
AND prev prem is determined
AND competition fac is determined
AND competition > 4
THEN prevprem quote is determined
AND prevprem quote:=prev prem*1.25+(0.25* renewal comp fac)
!
!       5. Renewal record for chiseling
!
RULE for determining premium based on renewal premium
IF renewal policy
AND renewal record is clean
AND prevprem quote is determined
THEN renewal is determined
AND premium := prevprem quote
ELSE renewal is determined
!
!       C. Supporting Business of Applicant
!       (Not on the first pass.)
!
RULE #1 for supporting business of asrd
IF asup bus IS a lot
THEN supporting business of asrd is determined
AND lots of asrd supporting business
AND asrd business fac := 0
!
RULE #2 for supporting business of asrd
IF asup bus IS some

```

```

THEN supporting business of asrd is determined
AND some asrd supporting business
AND asrd business fac := -5
!
RULE #3 for supporting business of asrd
IF asup bus IS none
THEN supporting business of asrd is determined
AND little asrd supporting business
AND asrd business fac := -10
!
! IV. APPLICANT GENERAL INFORMATION
!
! B. Receipts
!
! For receipts of < 1 mil, the minimum premium applies
!
RULE #2 for calculating receipts credit/penalty
IF total receipts < 2500000
THEN receipts credit is determined
AND rec fac := 0
!
RULE #3 for calculating receipts credit/penalty
IF total receipts > 2499000
AND total receipts < 5000000
THEN receipts credit is determined
AND rec fac := 10
!
RULE #4 for calculating receipts credit/penalty
IF total receipts > 4999000
AND total receipts < 10000000
THEN receipts credit is determined
AND rec fac := 15
!
RULE #5 for calculating receipts credit/penalty
IF total receipts > 9999000
AND total receipts < 25000000
THEN receipts credit is determined
AND rec fac := 25
!
RULE #6 for calculating receipts credit/penalty
IF total receipts > 24999000
THEN receipts credit is determined
AND rec fac := 33
!
! C. Payroll
!
! 1. Jones Act employees (shipboard)
!
RULE for determining input wet payroll
IF input wet payroll > 0
OR input wet payroll <= 0
THEN total wet payroll is determined
!
! 2. Non-shipboard payroll (magnitude of operation)
!
RULE for determining total dry payroll
IF total dry payroll > 0
OR total dry payroll <= 0
THEN total dry payroll is determined
!

```

```

!   D. Employees
!
!       1. Jones Act Employees (doublecheck payroll)
!
RULE for determining number of wet employees
IF num wet emps > 0
OR num wet emps <= 0
THEN num wet emps is determined
AND wet emp pyrl := 25000 * num wet emps
!
!       2. Non-shipboard Employees
!
RULE for determining number of dry employees
IF num dry emps > 0
OR num dry emps <= 0
THEN num dry emps is determined
!
! V. COMPETITIVE ENVIRONMENT
!
! This section does not ask any questions. It just
! translates a number from 1 to '0 (initialized at the
! beginning of the program) to a percent credit/penalty.
!
!       A. Lots of competition: credit
!
RULE #1 for converting comp scale to percent of prem
IF competition < 5
THEN competition fac is determined
AND comp fac := 25 - (competition * 5)
AND renewal comp fac := 33.3
!
!       B. Little competition: penalty
!
RULE #2 for converting comp scale to percent of prem
IF competition > 5
THEN competition fac is determined
AND comp fac := (0 - 7) * (competition - 5)
AND renewal comp fac := -33.3
!
RULE #3 for converting comp scale to percent of prem
IF competition = 5
THEN competition fac is determined
AND comp fac := (0 - 7) * (competition - 5)
AND renewal comp fac := 0
!
! VI. EXPOSURES
!
!       A. Exposures Unrelated to Line of Business
!
RULE for general exposures
IF CGL questions completed
AND wc questions completed
AND air questions completed
AND auto questions completed
THEN general exposures determined
!
!       B. Exposures Dependent on Line of Business
!
RULE for all exposures
IF general exposures determined

```

```

AND shiprepairer completed
AND vessel owner completed
THEN exposures determined
!
! VII. CALCULATE PREMIUMS
!
!     A. Premium Based on Payroll (for vo only)
!
!         1. Verify payroll amount
!
RULE #1 for total wet payroll
IF num wet emps is determined
!AND num dry emps is determined
AND wet emp pyrl > input wet payroll
THEN final payroll is determined
AND DISPLAY guy is lying
AND total wet payroll := wet emp pyrl
!
RULE #2 for total wet payroll
IF num wet emps is determined
!AND num dry emps is determined
AND wet emp pyrl <= input wet payroll
THEN final payroll is determined
AND total wet payroll := input wet payroll
!
!         2. Calculate the premium
!
RULE for calculating percent of payroll
IF final payroll is determined
THEN payroll quote is determined
AND credits := comp fac + brkr fac + asrd fac
AND adj base := 0.03 * (1- (credits / 100))
AND payroll quote := total wet payroll * adj base
!
!     B. Premium Based on Receipts
!
!         1. Calculate preliminary premium
!
!             Percentages are divided by 100 because they are
!             stated in whole numbers.
!
!             o For Shiprepairers
!
RULE #1 for calculating prelim percent of receipts
IF ask for shiprepairer
AND receipts credit is determined
THEN prelim receipts amt is determined
AND credits1 := comp fac + brkr fac + asrd fac + rec fac
AND credits2 := repair fac + vessel fac + locn fac
AND credits3 := govt fac + subk fac
AND credits := credits1 + credits2 + credits3
AND adj base := 0.0075 * (1- (credits / 100))
AND receipts quote := total receipts * adj base
!
!             o For Vessel Owners
!
! This rule is not used because vessel owners are not
! rated on receipts
!
RULE #2 for calculating prelim percent of receipts

```

```

IF ask for vessel owner
AND receipts credit is determined
AND NOT ask for shiprepairer
THEN prelim receipts amt is determined
AND credits := comp fac + brkr fac + asrd fac + rec fac
AND adj base := 0.0075 * (1- (credits / 100))
AND receipts quote := total receipts * adj base
!
!      2. Calculate Rate on line
!
! This is for the second pass. ROL is set to 10,000
!
!      Rate on Line is minimum policy premium.
!
RULE #1 for determining rate on line
IF asrd loss rec is determined
AND renewal policy is determined
AND lots of asrd supporting business
OR num years > 3
THEN rol is determined
AND rol := min rol
!
RULE #2 for determining rate on line
IF asrd loss rec is determined
AND renewal policy is determined
AND little asrd supporting business
OR num years < 3
OR num years = 3
THEN rol is determined
AND rol := rol
!
!      3. Determine premium based on receipts
!
RULE #1 for rate-on-line test and final pct of receipts
IF prelim receipts amt is determined
AND receipts quote < rol
THEN receipts quote is determined
AND receipts quote := rol
AND DISPLAY adjusted receipts results
!
RULE #2 for rate-on-line test and final pct of receipts
IF prelim receipts amt is determined
AND receipts quote >= rol
THEN receipts quote is determined
AND DISPLAY receipts results
!
! VIII. SHIP REPAIRER EXPOSURES
!
RULE #1 for shiprepairer questions
IF ask for shiprepairer
AND sr exposures determined
THEN shiprepairer completed
!
RULE #2 for shiprepairer questions
IF NOT ask for shiprepairer
THEN shiprepairer completed
!
RULE for determining sr exposures
IF sr primary is determined
AND repair fac is determined

```

```

AND vessel fac is determined
THEN sr exposures determined
!
!   A. Ship Repairer Primary Insurance
!
RULE for determining sr primary insurance
IF sr limit determined
AND sr prem determined
AND sr carrier determined
THEN sr primary is determined
!
!   1. Limit
!
RULE #1 for sr limit
IF sr limit < 500000
THEN sr limit determined
AND DISPLAY decline because of sr limit
AND rates are determined
!
RULE #2 for sr limit
IF sr limit >= 500000
AND sr limit < 1000000
THEN sr limit determined
AND low sr limit fac := -50
!
RULE #3 for sr limit
IF sr limit >= 1000000
THEN sr limit determined
AND low sr limit fac := 0
!
!   2. Premium
!
RULE for sr prem
IF sr premium > 0
OR sr premium <= 0
THEN sr prem determined
AND sr cr1 := low sr limit fac
AND sr cr2 := brkr fac + asrd fac
AND sr cr := sr cr1 + sr cr2
AND sr quote := 0.0075 * (1 - ( sr cr / 100))
!
!   3. Carrier
!
!   Possible carriers are: Aetna, Chub, Kemper,
!   AI, Lloyds, other
!
RULE #1 for carrier
IF sr carrier IS Aetna
OR sr carrier IS Chub
OR sr carrier IS Kemper
OR sr carrier IS AI
OR sr carrier IS Lloyds
THEN sr carrier determined
AND sr carrier expertise fac := 0
!
RULE #2 for carrier
IF sr carrier IS other carrier
AND sr carrier expertise determined
AND sr carrier rating determined
THEN sr carrier determined

```

```

!
!           a. Competence
!
RULE #1 for carrier expertise
IF sr expertise rate < 3
THEN sr carrier expertise determined
AND sr carrier expertise fac := 0
!
RULE #2 for carrier expertise
IF sr expertise rate >= 3
THEN sr carrier expertise determined
AND sr carrier expertise fac := -5
!
!           b. Best's Rating (solvency)
!
RULE #1 for determining sr carrier
IF sr carrier rating IS A or A plus
THEN sr carrier is ok
!
RULE #2 for determining sr carrier
IF sr carrier rating IS B plus
THEN sr carrier may not be ok
!
RULE #3 for determining sr carrier
IF sr carrier rating IS less than B plus
THEN sr carrier is unacceptable
!
RULE #4 for determining sr carrier
IF sr carrier is ok
THEN sr carrier rating determined
!
RULE #5 for determining sr carrier
IF sr carrier is unacceptable
THEN sr carrier rating determined
AND DISPLAY decline coverage
!
RULE #6 for determining sr carrier
IF sr carrier may not be ok
AND small sr primary carrier
THEN sr carrier rating determined
AND DISPLAY might decline coverage
!
RULE #7 for determining sr carrier
IF sr carrier may not be ok
AND NOT small sr primary carrier
THEN sr carrier rating determined
!
!           B. Repair Type
!
RULE #1 for repair fac
IF repair type IS structural
THEN repair fac is determined
AND repair fac := 0
!
RULE #2 for repair fac
IF repair type IS engine
THEN repair fac is determined
AND repair fac := -5
!
RULE #3 for repair fac

```

```

IF repair type IS both engine and structural
THEN repair fac is determined
AND repair fac := -3
!
!   C. Vessel Type
!
RULE #1 for vessel fac
IF vessel type IS rig
THEN vessel fac is determined
AND vessel fac := -50
!
RULE #2a for vessel fac
IF vessel type IS commercial
AND NOT repair is potentially gas freeing
THEN vessel fac is determined
AND vessel fac := 0
!
RULE #2b for vessel fac
IF vessel type IS commercial
AND repair is potentially gas freeing
THEN vessel fac is determined
AND vessel fac := -15
!
RULE #3 for vessel fac
IF vessel type IS not commercial
THEN vessel fac is determined
AND vessel fac := 10
!
!   E. Government Work
!
RULE for government factor
IF sr work is for the government
THEN govt fac is determined
AND govt fac := 5
ELSE govt fac is determined
AND govt fac := 0
!
!   F. Subcontracting
!
RULE #1 for subcontractor factor
IF more than 25 pct of work subcontracted on premises
THEN ask subk questions
!
RULE #2 for subcontractor factor
IF NOT ask subk questions
THEN subk fac is determined
AND subk fac := 0
!
RULE #3 for subcontractor factor
IF ask subk questions
AND hold harmless agreement exists with subcontractor
AND Best rating of subcontractors insurer is A or A plus
THEN subk fac is determined
AND subk fac := 0
!
RULE #4 for subk questions
IF ask subk questions
AND NOT hold harmless agreement exists with subcontractor
OR NOT Best rating of subcontractors insurer is A or A plus
THEN subk fac is determined

```



```

AND subk fac := -10
!
! IX. VESSEL OWNER EXPOSURES
!
RULE #1 for vessel owner questions
IF ask for vessel owner
AND vo exposures determined
THEN vessel owner completed
!
RULE #2 for vessel owner questions
IF NOT ask for vessel owner
THEN vessel owner completed
!
RULE for determining vo exposures
IF schedule of vessels is determined
AND vo primary is determined
AND barge fleet credits calculated
THEN vo exposures determined
AND vo cred := brkr fac + asrd fac + comp fac
AND per vessel quote := per vessel quote * (1-(vo cred/100))
!
!     A. Protection & Indemnity (P&I) Primary Insurance
!
RULE #1 for determining vo primary insurance
IF applicant has a P and I policy
AND vo limit determined
AND vo prem determined
AND vo carrier determined
AND cargo exclusion determined
THEN vo primary is determined
!
RULE #2 for determining vo primary insurance
IF NOT applicant has a P and I policy
AND CGL watercraft deletion questions asked
THEN vo primary is determined
!
!     1. Carrier
!
RULE #1 for P and I carrier
IF vo carrier IS Carrier #1
OR vo carrier IS Carrier #2
OR vo carrier IS Carrier #3
THEN vo carrier determined
AND vo carrier expertise fac := 0
!
RULE #2 for P and I carrier
IF vo carrier IS other carrier
AND vo carrier expertise determined
AND vo carrier rating determined
THEN vo carrier determined
!
!     a. Competence
!
RULE #1 for carrier expertise
IF vo expertise rate < 3
THEN vo carrier expertise determined
AND vo carrier expertise fac := 0
!
RULE #2 for carrier expertise
IF vo expertise rate >= 3

```

```

THEN vo carrier expertise determined
AND vo carrier expertise fac := -5
!
!           b. Best's Rating (solvency)
!
RULE #1 for determining vo carrier
IF vo carrier rating IS A or A plus
THEN vo carrier is ok
!
RULE #2 for determining vo carrier
IF vo carrier rating IS B plus
THEN vo carrier may not be ok
!
RULE #3 for determining vo carrier
IF vo carrier rating IS less than B plus
THEN vo carrier is unacceptable
!
RULE #4 for determining vo carrier
IF vo carrier is ok
THEN vo carrier determined
!
RULE #5 for determining vo carrier
IF vo carrier is unacceptable
THEN vo carrier determined
AND DISPLAY decline coverage
!
RULE #6 for determining vo carrier
IF vo carrier may not be ok
AND small vo primary carrier
THEN vo carrier determined
AND DISPLAY might decline coverage
!
RULE #7 for determining vo carrier
IF vo carrier may not be ok
AND NOT small vo primary carrier
THEN vo carrier determined
!
!           2. Limit
!
RULE #1 for vo limit
IF vo limit < 500000
THEN vo limit determined
AND DISPLAY decline because of vo limit
AND rates are determined
!
RULE #2 for vo limit
IF vo limit >= 500000
AND vo limit < 1000000
THEN vo limit determined
AND low vo limit fac := -50
!
RULE #3 for vo limit
IF vo limit >= 1000000
THEN vo limit determined
AND low vo limit fac := 0
!
!           3. Premium
!
RULE for PandI quote
IF vo limit determined

```

AND vo carrier determined
AND limit factors determined
THEN vo prem determined
AND vo cred1 := low vo limit fac + vo carrier expertise fac
AND vo cred2 := extent fac + collision fac
AND vo cred := vo cred1 + vo cred2
AND PandI quote := 0.0075 * (1 - (vo cred/100)) * vo premium

!

!

4. Watercraft Exclusion Deleted From CGL Policy

!

RULE #1 for asking CGL watercraft deletion questions
IF MEL and ROW are covered
THEN CGL watercraft deletion questions asked

!

RULE #2 for asking CGL watercraft deletion questions
IF NOT MEL and ROW are covered
THEN CGL watercraft deletion questions asked
AND DISPLAY ff wreck removal

!

!

5. P&I form: is cargo excluded from coverage?

!

RULE #1 for determining if cargo is excluded from P&I
IF NOT P and I form is SP 38
THEN cargo exclusion determined

!

RULE #2 for determining if cargo is excluded from P&I
IF P and I form is SP 38
AND cargo is covered
THEN cargo exclusion determined

!

RULE #3 for determining if cargo is excluded from P&I
IF P and I form is SP 38
AND NOT cargo is covered
AND cargo is owned
THEN cargo exclusion determined
AND DISPLAY cargo is not covered

!

RULE #4 for determining if cargo is excluded from P&I
IF P and I form is SP 38
AND NOT cargo is covered
AND NOT cargo is owned
THEN cargo exclusion determined
AND DISPLAY ff cargo exclusion

!

!

6. P&I Limit Restrictions

!

RULE for determining P&I limit factors
IF limit extent credit is determined
AND limit wrt value of vessel is determined
THEN limit factors determined

!

!

a. Determine if limit applies to vessel
or to peril

!

RULE #1 for determining limit extent credit
IF limit extent is determined
AND multiowned boat collision is danger
AND likelihood of multiowned boat collision is determined
AND multiowned boat collision is likely
THEN limit extent credit is determined

```

AND extent fac := 10
!
RULE #2 for determining limit extent credit
IF limit extent is determined
AND multiowned boat collision is danger
AND likelihood of multiowned boat collision is determined
AND NOT multiowned boat collision is likely
THEN limit extent credit is determined
AND extent fac := 0
!
RULE #3 for determining limit extent credit
IF limit extent is determined
AND multiperil accident is danger
THEN limit extent credit is determined
AND extent fac := 10
!
!
RULE #1 for determining limit extent
IF limit extent IS limit on each vessel
OR limit extent IS limit on each occurrence
THEN multiperil accident is danger
AND NOT multiowned boat collision is danger
AND limit extent is determined
!
RULE #2 for determining limit extent
IF limit extent IS sep limits for PI and collision/towers
THEN multiowned boat collision is danger
AND NOT multiperil accident is danger
AND limit extent is determined
!
RULE #1 for likelihood of multi-owned boat collision
IF schedule of vessels is determined
AND total barges > 0
THEN likelihood of multiowned boat collision is determined
AND multiowned boat collision is likely
!
RULE #2 for likelihood of multi-owned boat collision
IF schedule of vessels is determined
AND total barges = 0
THEN likelihood of multiowned boat collision is determined
AND NOT multiowned boat collision is likely
!
!           b. Ask if limit covers full value of vessel
!
RULE #1 for determining limit wrt value of vessel
IF schedule of vessels is determined
AND vo limit determined
AND max vessel value < vo limit
AND P and I covers excess RDC, towers
AND half limit := vo limit / 2
AND max vessel value >= half limit
THEN limit wrt value of vessel is determined
AND collision fac := 5
!
RULE #2 for determining limit wrt value of vessel
IF schedule of vessels is determined
AND vo limit determined
AND max vessel value < vo limit
AND P and I covers excess RDC, towers
AND half limit := vo limit / 2

```

```

AND max vessel value < half limit
THEN limit wrt value of vessel is determined
AND collision fac := 0
!
RULE #3 for determining limit wrt value of vessel
IF schedule of vessels is determined
AND vo limit determined
AND max vessel value < vo limit
AND NOT P and I covers excess RDC, towers
THEN limit wrt value of vessel is determined
AND DISPLAY P and I does not cover xs RDC, investigate
AND collision fac := 0
!
RULE #4 for determining limit wrt value of vessel
IF schedule of vessels is determined
AND vo limit determined
AND max vessel value >= vo limit
AND col tow limit type determined
AND col tow limit is hull value
THEN limit wrt value of vessel is determined
AND collision fac := 10
!
RULE #5 for determining limit wrt value of vessel
IF schedule of vessels is determined
AND vo limit determined
AND max vessel value >= vo limit
AND col tow limit type determined
AND col tow limit is P and I limit
THEN limit wrt value of vessel is determined
AND collision fac := -10
!
RULE #1 for determining collision, towers limit type
IF ctl IS hull value
THEN col tow limit is hull value
AND col tow limit type determined
!
RULE #2 for determining collision, towers limit type
IF ctl IS P and I limit
THEN col tow limit is P and I limit
AND col tow limit type determined
!
!
!       7. Schedule of Vessels
!
RULE for determining schedule of vessels
IF barge prem determined
AND tug prem determined
AND crewsupply prem determined
THEN schedule of vessels is determined
!
!       a. Tugs
!
!       - tug premium -
!
RULE #1 for determining tug premium
IF total tugs = 0
THEN tug prem determined
!
RULE #2 for determining tug premium
IF total tugs > 0

```

```

AND tug value determined
AND tug crew contrib determined
AND towers contrib determined
AND tug location determined
AND tug age determined
THEN tug prem determined
AND tug base := 750 + crew contrib + towers contrib
AND tug credits := tug age fac + locn fac + river fac
AND tug prem:=total tugs * tug base * (1 -(tug credits/100))
AND per vessel quote := per vessel quote + tug prem
!
!           - tug value -
!
!
RULE for tug value and adjusting max vessel value
IF tug value > max vessel value
THEN tug value determined
AND max vessel value := tug value
ELSE tug value determined
!
!           - tug crew contribution -
!
!
RULE for crew contribution to the premium
IF dummy
THEN tug crew contrib determined
AND crew contrib := number of crew on tug * 750
!
!           - tug towers contribution -
!
!
RULE for calculating risk due to towers liability
IF tug special cargo determined
AND tug cargo determined
THEN towers contrib determined
AND towers credits1 := tug haz fac + tug rig fac
AND towers credits2 := tug tandem fac + tug own fac
AND towers credits := towers credits1 + towers credits2
AND towers contrib := 1500 * (1 - (towers credits / 100))
!
!           - - special cargo
!
!
RULE for determining special cargo
IF tandem tows asked
AND pull rigs determined
AND no special cargo determined
THEN tug special cargo determined
!
!
RULE #1 for special cargo (tandem tows, rigs)
IF special cargo IS tandem tows
THEN tandem tows asked
AND tandem tows
AND tug tandem fac := -50
ELSE tandem tows asked
AND NOT tandem tows
AND tug tandem fac := 0
!
!
RULE #2 for special cargo (tandem tows, rigs)
IF special cargo IS rigs
THEN pull rigs determined
AND tug rig fac := -400
ELSE pull rigs determined
AND tug rig fac := 0

```

```

!
RULE #3 for special cargo (tandem tows, rigs)
IF special cargo IS neither
THEN no special cargo determined
ELSE no special cargo determined
!
!           - - cargo (esp. what the tug pulls)
!
! If he tows his own barges then ask the cargo
! questions when you ask about barges.
!
RULE for determining cargo risks
IF tug cargo ownership determined
AND tug hazardous cargo determined
THEN tug cargo determined
!
!           o Tug owner pulls his own barges?
!
! credit, if he does, because he can't sue himself
!
RULE #1 for tug/barge-pulled-by-tug cargo ownership
IF total barges > 0
AND tow own barge
THEN tug cargo ownership determined
AND tug own fac := 0
!
RULE #2 for tug/barge-pulled-by-tug cargo ownership
IF total barges > 0
AND NOT tow own barge
THEN tug cargo ownership determined
AND tug own fac := 50
!
RULE #3 for tug/barge-pulled-by-tug cargo ownership
IF total barges = 0
THEN tug cargo ownership determined
AND tug own fac := 0
!
!           o Pulls hazardous cargo?
!
RULE for determining tug/barge-pulled-by-tug cargo
IF tug cargo is hazardous
THEN tug hazardous cargo determined
AND tug haz fac := -50
ELSE tug hazardous cargo determined
AND tug haz fac := 0
!
!           - tug location -
!
! do not penalize him for being on the river and
! being a tandem tower
!
RULE #1 for determining tug location
IF location is east coast
OR location is gulf
THEN tug location determined
AND river fac := 0
!
RULE #2 for determining tug location
IF location is other
AND location is river

```

```

AND tandem tows
THEN tug location determined
AND NOT location is other
AND river fac := -350
!
RULE #3 for determining tug location
IF location is other
AND location is river
AND NOT tandem tows
THEN tug location determined
AND NOT location is other
AND river fac := -400
!
RULE #4 for determining tug location
IF location is other
AND NOT location is river
THEN tug location determined
AND river fac := 0
!
!           - tug age -
!
RULE #1 for determining tug age
IF tug age < 5
THEN tug age determined
AND tug age fac := 10
!
! ask for survey on another pass
!
!RULE #2 for determining tug age
!IF tug age >= 5
!AND last survey > 3
!THEN tug age determined
!AND tug age fac := 0
!
RULE #3 for determining tug age
IF tug age >= 5
!AND NOT last survey > 3
THEN tug age determined
AND tug age fac := 5
!
!           b. Barges
!
!           - barge premium -
!
RULE #1 for determining barge premium
IF dry barges = 0
AND liquid barges = 0
THEN barge prem determined
AND total barges := 0
!
RULE #2 for determining barge premium
IF dry barges > 0
OR liquid barges > 0
AND total barges := dry barges + liquid barges
AND barge value determined
AND barge cargo determined
AND barge cargo ownership determined
AND barge age determined
THEN barge prem determined
AND barge base amt:=500+barge cargo contrib+barge own cargo

```



```

AND barge prem := barge base amt * (1 - (barge age fac/100))
AND per vessel quote := per vessel quote + barge prem
!
!           - barge value -
!
RULE for determining barge value
IF barge value > max vessel value
THEN barge value determined
AND max vessel value := barge value
ELSE barge value determined
!
!           - barge cargo exposures -
!
RULE #1 for calculating barge cargo exposures
IF liquid barges > 0
AND liquid cargo is a pollutant or is hazardous
THEN barge cargo determined
AND tug cargo is hazardous
AND cs cargo is hazardous
AND barge cargo contrib := 500
!
RULE #2 for calculating barge cargo exposures
IF liquid barges > 0
AND NOT liquid cargo is a pollutant or is hazardous
THEN barge cargo determined
AND NOT tug cargo is hazardous
AND NOT cs cargo is hazardous
AND barge cargo contrib := 0
!
RULE #3 for calculating barge cargo exposures
IF liquid barges = 0
THEN barge cargo determined
AND NOT tug cargo is hazardous
AND NOT cs cargo is hazardous
AND barge cargo contrib := 0
!
RULE for calculating barge cargo ownership
IF dry barges > 0
AND NOT barge cargo is owned
THEN barge cargo ownership determined
AND barge own cargo := 250
ELSE barge cargo ownership determined
AND barge own cargo := 0
!
!           - barge age -
!
RULE #1 for determining barge age
IF barge age < 5
THEN barge age determined
AND barge age fac := 10
!
!RULE #2 for determining barge age
!IF barge age >= 5
!AND last survey > 3
!THEN barge age determined
!AND barge age fac := 0
!
RULE #3 for determining barge age
IF barge age >= 5
!AND NOT last survey > 3

```

```

THEN barge age determined
AND barge age fac := 5
!
!           c. crewboats and supplyboats
!
!           - crewsupply premium -
!
!   towers only applies for tug-supply boats.
!   can identify a tug-supply bec it is very big.
!   Otherwise, a crewboat or supplyboat is rated like a tug.
!
RULE #1 for collecting crewsupply information
IF total crewsupply = 0
THEN crewsupply prem determined
!
RULE #2 for determining crewsupply premium
IF crewsupply value determined
AND crewsupply crew contrib determined
AND cs location determined
AND crewsupply age determined
THEN crewsupply prem determined
AND cs base amt := 750 + cs crew contrib + cs towers contrib
AND cs credits:=crewsupply age fac + locn fac + cs river fac
AND cs prem := cs base amt * (1 - (cs credits / 100))
AND per vessel quote := per vessel quote + cs prem
!
!           - crewsupply value -
!
RULE for determining crewsupply value
IF max value adjusted
AND tugsupply determined
THEN crewsupply value determined
!
RULE for adjusting max vessel value
IF crewsupply value > max vessel value
THEN max value adjusted
AND max vessel value := crewsupply value
ELSE max value adjusted
!
RULE for determining if the boat is also a tug
IF tugsupply suspected
AND boat is a tugsupply
AND cs towers contrib determined
THEN tugsupply determined
ELSE tugsupply determined
AND cs towers contrib := 0
!
RULE for suspecting that the boat is a tug-supply boat
IF crewsupply value > 1000000
OR crewsupply horsepower > 1000
THEN tugsupply suspected
ELSE dummy
AND NOT tugsupply suspected
!
!           - crewsupply crew contribution -
!
RULE for crewsupply crew contribution to the premium
IF dummy
THEN crewsupply crew contrib determined
AND cs crew contrib := number of crew on crewsupply * 750

```

```

!
!           - tugsupply towers contribution -
!
RULE for calculating towers risk for tugsupply boats
IF cs special cargo determined
AND cs cargo determined
THEN cs towers contrib determined
AND cs tow credits1 := cs haz fac + cs rig fac
AND cs tow credits2 := cs tandem fac + cs own fac
AND cs tow credits := cs tow credits1 + cs tow credits2
AND cs towers contrib := 1500 * (1 - (cs tow credits/100))
!
!           - - special cargo
!
RULE for determining cs special cargo
IF cs tandem tows asked
AND cs pull rigs determined
AND cs no special cargo determined
THEN cs special cargo determined
!
RULE #1 for cs special cargo
IF cs special cargo IS tandem tows
THEN cs tandem tows asked
AND tandem tows
AND cs tandem fac := -50
ELSE cs tandem tows asked
AND NOT tandem tows
AND cs tandem fac := 0
!
RULE #2 for cs special cargo
IF cs special cargo IS rigs
THEN cs pull rigs determined
AND cs rig fac := -400
ELSE cs pull rigs determined
AND cs rig fac := 0
!
RULE #3 for cs special cargo
IF cs special cargo IS neither
THEN cs no special cargo determined
ELSE cs no special cargo determined
!
!           - - cargo (esp. what the tugsupply pulls)
!
!   if he also owns tugs, then the cargo factors
!   were asked in the tug section.
!
RULE #1 for determining cs cargo risks
IF total tugs > 0
THEN cs cargo determined
AND cs own fac := tug own fac
AND cs haz fac := tug haz fac
!
RULE #2 for determining cs cargo risks
IF total tugs = 0
AND cs cargo ownership determined
AND cs hazardous cargo determined
THEN cs cargo determined
!
!           o Tug owner pulls his own barge?
!

```

```

RULE for cs/barge-pulled-by-cs cargo
IF total barges > 0
AND tow own barge
THEN cs cargo ownership determined
AND cs own fac := 0
ELSE cs cargo ownership determined
AND cs own fac := 50
!
!           o Pulls hazardous cargo?
!
RULE for determining tug-supp's and barge's cargo
IF cs cargo is hazardous
THEN cs hazardous cargo determined
AND cs haz fac := -50
ELSE cs hazardous cargo determined
AND cs haz fac := 0
!
!           - crewsupply location -
!
!   if he has tugs, then he answered this question already
!
RULE #1 for determing cs location
IF total tugs > 0
THEN cs location determined
AND cs river fac := river fac
!
RULE #2 for determining cs location
IF location is east coast
OR location is gulf
THEN cs location determined
AND cs river fac := 0
!
RULE #3 for determining cs location
IF location is other
AND location is river
AND tandem tows
THEN cs location determined
AND cs river fac := -350
!
RULE #4 for determining cs location
IF location is other
AND location is river
AND NOT tandem tows
THEN cs location determined
AND cs river fac := -400
!
RULE #5 for determining cs location
IF location is other
AND NOT location is river
THEN cs location determined
AND cs river fac := 0
!
!           - crewsupply age -
!
RULE #1 for determining crewsupply age
IF crewsupply age < 5
THEN crewsupply age determined
AND crewsupply age fac := 10
!
!RULE #2 for determining crewsupply age

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```

!IF crewsupply age >= 5
!AND last survey > 3
!THEN crewsupply age determined
!AND crewsupply age fac := 0
!
RULE #3 for determining crewsupply age
IF crewsupply age >= 5
!AND NOT last survey > 3
THEN crewsupply age determined
AND crewsupply age fac := 5
!
!           8. Barge Fleet Credits
!
RULE #1 for calculating barge fleet credits
IF total barges <= 5
THEN barge fleet credits calculated
!
RULE #2 for calculating barge fleet credits
IF total barges > 5
AND total barges <= 10
THEN barge fleet credits calculated
AND barge credit := total barge prem * 0.33
AND per vessel quote := per vessel quote - barge credit
!
RULE #3 for calculating barge fleet credits
IF total barges > 10
THEN barge fleet credits calculated
AND barge credit := total barge prem * 0.66
AND per vessel quote := per vessel quote - barge credit
!
! X. UNDERLYING INSURANCE FOR GENERAL EXPOSURES
!
!     A. Comprehensive General Liability
!
RULE for obtaining CGL info
IF CGL limit determined
AND CGL carrier determined
AND CGL form determined
AND CGL premium determined
THEN CGL questions completed
!
!           1. CGL form (claims-made?)
!
!   Note: Must also ask for number of aggregates
!
RULE #1 for determining CGL form
IF CGL form is claims made
AND retro date less than three years
AND discovery period less than six months
THEN CGL form determined
AND DISPLAY use Marks form
!
RULE #2 for determining CGL form
IF CGL form is claims made
AND NOT retro date less than three years
OR NOT discovery period less than six months
THEN CGL form determined
AND DISPLAY consider declining claims made
!
RULE #3 for determining CGL form

```

```

IF NOT CGL form is claims made
THEN CGL form determined
!
!       2. Carrier
!
RULE #1 for CGL carrier
IF CGL carrier IS Aetna
OR CGL carrier IS Chub
OR CGL carrier IS Kemper
OR CGL carrier IS AI
OR CGL carrier IS Lloyds
THEN CGL carrier determined
AND CGL carrier expertise fac := 0
!
RULE #2 for CGL carrier
IF CGL carrier IS other carrier
AND CGL carrier expertise determined
THEN CGL carrier determined
!
!       a. Competence
!
RULE #1 for CGL carrier expertise
IF CGL expertise rate < 3
THEN CGL carrier expertise determined
AND CGL carrier expertise fac := 0
!
RULE #2 for CGL carrier expertise
IF CGL expertise rate >= 3
THEN CGL carrier expertise determined
AND CGL carrier expertise fac := -5
!
!       b. Best's rating (solvency)
!
RULE #1 for determining CGL carrier
IF CGL carrier rating IS A or A plus
THEN CGL carrier is ok
!
RULE #2 for determining CGL carrier
IF CGL carrier rating IS B plus
THEN CGL carrier may not be ok
!
RULE #3 for determining CGL carrier
IF CGL carrier rating IS less than B plus
THEN CGL carrier is unacceptable
!
RULE #4 for determining CGL carrier
IF CGL carrier is ok
THEN CGL carrier determined
!
RULE #5 for determining CGL carrier
IF CGL carrier is unacceptable
THEN CGL carrier determined
AND DISPLAY decline coverage
!
RULE #6 for determining CGL carrier
IF CGL carrier may not be ok
AND small CGL primary carrier
THEN CGL carrier determined
AND DISPLAY might decline coverage
!

```

```

RULE #7 for determining CGL carrier
IF CGL carrier may not be ok
AND NOT small CGL primary carrier
THEN CGL carrier determined
!
!       3. Limit
!
RULE #1 for CGL limit
IF CGL limit < 1000000
THEN CGL limit determined
AND DISPLAY decline because of CGL limit
AND rates are determined
!
RULE #2 for CGL limit
IF CGL limit >= 1000000
THEN CGL limit determined
!
!       4. Premium
!
RULE for CGL prem
IF CGL premium >= 0
THEN CGL premium determined
AND CGL cred:=brkr fac+ asrd fac
AND CGL quote := 0.50 * (1-(CGL cred / 100))
!
!       B. Auto
!
RULE #1 for obtaining auto info
IF autos owned or leased
AND auto quote is determined
THEN auto questions completed
!
RULE #2 for obtaining auto info
IF NOT autos owned or leased
THEN auto questions completed
AND auto quote := 0
!
!       1. Auto Exposure Questions
!
!           To estimate the underlying premium
!
!           a. cars, trucks, tractor/trailers
!
RULE for estimating auto underlying premium
IF private cars determined
AND trucks determined
AND tractors determined
THEN auto prem estimated
AND auto estimate := auto num + truck num + trac num
!
RULE for number of owned private cars, etc.
IF owned autos >= 0
THEN private cars determined
AND auto num := owned autos * 500
!
RULE for number of owned trucks
IF owned trucks >= 0
THEN trucks determined
AND truck num := owned trucks * 1000
!

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```

RULE for number of owned tractor/trailers
IF owned tractors >= 0
THEN tractors determined
AND trac num := owned tractors * 1500
!
!           b. Cargo exposures
!
RULE #1 for asking cargo questions
IF auto cargo legal exposure
AND hazardous cargo is determined
THEN auto cargo questions asked
!
RULE #2 for asking cargo questions
IF NOT auto cargo legal exposure
THEN auto cargo questions asked
AND auto min limit := 0
!
RULE #1 for determining if cargo is hazardous
IF auto cargo is hazardous
AND cargo is explosive or flammable
AND auto cargo is owned
THEN hazardous cargo is determined
AND DISPLAY decline because of hazardous cargo
AND auto min limit := 5000000
!
RULE #2 for determining if cargo is hazardous
IF auto cargo is hazardous
AND NOT cargo is explosive or flammable
THEN hazardous cargo is determined
AND auto min limit := 5000000
!
RULE #3 for determining if cargo is hazardous
IF auto cargo is hazardous
AND cargo is explosive or flammable
AND NOT auto cargo is owned
THEN hazardous cargo is determined
AND auto min limit := 5000000
!
RULE #4 for determining if cargo is hazardous
IF NOT auto cargo is hazardous
THEN hazardous cargo is determined
AND auto min limit := 1000000
!
!           2. Underlying auto insurance information
!
RULE for obtaining underlying auto info
IF auto limit determined
AND auto carrier determined
AND auto premium determined
THEN underlying auto questions completed
!
!           a. Carrier
!
RULE #1 for auto carrier
IF auto carrier IS carrier #1
OR auto carrier IS carrier #2
OR auto carrier IS carrier #3
THEN auto carrier determined
AND auto carrier expertise fac := 0
!

```



```

RULE #2 for auto carrier
IF auto carrier IS other carrier
AND auto carrier expertise determined
THEN auto carrier determined
!
!           i. Competence
!
RULE #1 for auto carrier expertise
IF auto expertise rate < 3
THEN auto carrier expertise determined
AND auto carrier expertise fac := 0
!
RULE #2 for auto carrier expertise
IF auto expertise rate >= 3
THEN auto carrier expertise determined
AND auto carrier expertise fac := -5
!
!           ii. Best's rating (solvency)
!
RULE #1 for determining auto carrier
IF auto carrier rating IS A or A plus
THEN auto carrier is ok
!
RULE #2 for determining auto carrier
IF auto carrier rating IS B plus
THEN auto carrier may not be ok
!
RULE #3 for determining auto carrier
IF auto carrier rating IS less than B plus
THEN auto carrier is unacceptable
!
RULE #4 for determining auto carrier
IF auto carrier is ok
THEN auto carrier determined
!
RULE #5 for determining auto carrier
IF auto carrier is unacceptable
THEN auto carrier determined
AND DISPLAY decline coverage
!
RULE #6 for determining auto carrier
IF auto carrier may not be ok
AND small auto primary carrier
THEN auto carrier determined
AND DISPLAY might decline coverage
!
RULE #7 for determining auto carrier
IF auto carrier may not be ok
AND NOT small auto primary carrier
THEN auto carrier determined
!
!           b. Limit
!
RULE #1 for auto limit
IF auto cargo questions asked
AND auto limit < auto min limit
THEN auto limit determined
AND DISPLAY decline because of auto limit
!
RULE #2 for auto limit

```

```

IF auto cargo questions asked
AND auto limit >= auto min limit
THEN auto limit determined
!
!           c. Premium
!
RULE for auto prem
IF auto premium >= 0
THEN auto premium determined
!
!           3. Premium based on Auto underlying premium
!
RULE #1 for determining auto quote
IF auto prem estimated
AND underlying auto questions completed
AND high end := 1.10 * auto estimate
AND high end < auto premium
THEN auto quote is determined
AND auto quote := 0.5 * auto premium
AND DISPLAY check auto exposure because input prem is high
!
RULE #2 for determining auto quote
IF auto prem estimated
AND underlying auto questions completed
AND low end := 0.90 * auto estimate
AND low end > auto premium
THEN auto quote is determined
AND auto quote := 0.5 * auto estimate
AND DISPLAY check auto exposure because input prem is low
!
RULE #3 for determining auto quote
IF auto prem estimated
AND underlying auto questions completed
AND low end := 0.90 * auto estimate
AND high end := 1.10 * auto estimate
AND low end <= auto premium
AND high end >= auto premium
THEN auto quote is determined
AND auto quote := 0.5 * auto estimate
!
!           C. Air
!
RULE #1 for obtaining air info
IF aircraft owned or leased
AND required limit determined
AND underlying air questions asked
THEN air questions completed
!
RULE #2 for obtaining air info
IF NOT aircraft owned or leased
THEN air questions completed
!
RULE for obtaining underlying air info
IF air carrier determined
AND air carrier expertise determined
AND air limit determined
AND air premium determined
THEN underlying air questions asked
!
!           1. Number of Owned Aircraft

```

```

!
!           To determine minimum underlying covg required
!
RULE #1 for number of owned aircraft
IF owned aircraft > 0
AND number of seats >= 5
THEN required limit determined
AND required limit := number of seats * 1000000
!
RULE #2 for number of owned aircraft
IF owned aircraft > 0
AND number of seats < 5
THEN required limit determined
AND required limit := 5000000
!
RULE #3 for number of owned aircraft
IF owned aircraft = 0
AND leased aircraft > 0
THEN required limit determined
AND required limit := 1000000
!
!           2. Carrier
!
RULE #1 for air carrier
IF air carrier IS US AIG
OR air carrier IS AAAU
OR air carrier IS Federal
OR air carrier IS Lloyds
THEN air carrier determined
AND air carrier expertise fac := 0
!
RULE #2 for air carrier
IF air carrier IS other carrier
AND air carrier expertise determined
THEN air carrier determined
!
!           a. Competence
!
RULE #1 for air carrier expertise
IF air expertise rate < 3
THEN air carrier expertise determined
AND air carrier expertise fac := 0
!
RULE #2 for air carrier expertise
IF air expertise rate >= 3
THEN air carrier expertise determined
AND air carrier expertise fac := -5
!
!           b. Best's rating (solveny)
!
RULE #1 for determining air carrier
IF air carrier rating IS A or A plus
THEN air carrier is ok
!
RULE #2 for determining air carrier
IF air carrier rating IS B plus
THEN air carrier may not be ok
!
RULE #3 for determining air carrier
IF air carrier rating IS less than B plus

```

```

THEN air carrier is unacceptable
!
RULE #4 for determining air carrier
IF air carrier is ok
THEN air carrier determined
!
RULE #5 for determining air carrier
IF air carrier is unacceptable
THEN air carrier determined
AND DISPLAY decline coverage
!
RULE #6 for determining air carrier
IF air carrier may not be ok
AND small air primary carrier
THEN air carrier determined
AND DISPLAY might decline coverage
!
RULE #7 for determining air carrier
IF air carrier may not be ok
AND NOT small air primary carrier
THEN air carrier determined
!
!       3. Limit
!
RULE #1 for air limit
IF air limit < required limit
THEN air limit determined
AND DISPLAY decline because of air limit
AND NOT rates are determined
AND stop the program
!
RULE #2 for air limit
IF air limit >= required limit
THEN air limit determined
!
!       3. Premium
!
RULE for air prem
IF air premium > 0
OR air premium <= 0
THEN air premium determined
!
!       D. Workman's Comp
!
RULE for obtaining wc info
!IF wc carrier determined
!AND wc carrier expertise determined
IF wc limit determined
THEN wc questions completed
!
!       1. Carrier
!
!       a. Competence
!
RULE #1 for wc carrier expertise
IF wc expertise rate < 3
THEN wc carrier expertise determined
AND wc carrier expertise fac := 0
!
RULE #2 for wc carrier expertise

```

```

IF wc expertise rate >= 3
THEN wc carrier expertise determined
AND wc carrier expertise fac := -5
!
!           b. Best's rating (solvency)
!
RULE #1 for determining wc carrier
IF wc carrier rating IS A or A plus
THEN wc carrier is ok
!
RULE #2 for determining wc carrier
IF wc carrier rating IS B plus
THEN wc carrier may not be ok
!
RULE #3 for determining wc carrier
IF wc carrier rating IS less than B plus
THEN wc carrier is unacceptable
!
RULE #4 for determining wc carrier
IF wc carrier is ok
THEN wc carrier determined
!
RULE #5 for determining wc carrier
IF wc carrier is unacceptable
THEN wc carrier determined
AND DISPLAY decline coverage
!
RULE #6 for determining wc carrier
IF wc carrier may not be ok
AND small wc primary carrier
THEN wc carrier determined
AND DISPLAY might decline coverage
!
RULE #7 for determining wc carrier
IF wc carrier may not be ok
AND NOT small wc primary carrier
THEN wc carrier determined
!
!           2. Limit (only need to know if statutory)
!
RULE #1 for wc limit
IF statutory limit for wc insurance
OR NOT statutory limit for wc insurance
THEN wc limit determined
!
RULE #2 for wc limit
IF NOT statutory limit for wc insurance
THEN wc limit determined
AND DISPLAY decline because of wc limit
!
! - - - - -
! -           T           E           X           T           -
! - - - - -
!
!
TEXT brkr
Select the broker for the application:
!
TEXT brkr reln
What is the loss record of the broker?
!

```

TEXT brkr sup bus
How would you describe the amount of supporting
business of the broker?
!
TEXT previous bumbershoot premium is known
Is the premium for the past year's umbrella liability
policy known?
!
TEXT renewal rec
What is the loss record on the policy to renew?
!
TEXT renewal policy
Is this a renewal policy?
!
TEXT previous bumbershoot premium
Enter the premium for the previous umbrella policy:
!
TEXT avg claim in excess of \$10,000
Enter the amount of the average claim in excess of \$10,000
over the past five years:
!
TEXT location
Where does the applicant operate?
!
TEXT asup bus
How would you describe the amount of supporting
business of the applicant?
!
TEXT line of business
Select the line of business of the applicant. You
may select more than one.
!
TEXT total receipts
Enter the amount of total receipts of the applicant's business:
!
TEXT input wet payroll
Enter total payroll amount for shipboard employees:
!
TEXT total dry payroll
Enter total payroll amount for non-shipboard employees:
!
TEXT num wet emps
Enter the number of shipboard employees:
!
TEXT num dry emps
Enter the number of non-shipboard employees:
!
TEXT number of years of renewal
Enter the number of years the applicant
has been renewing his policy:
!
TEXT sr carrier
Select the carrier for the Ship Repairer Legal Liability primary insurance
!
TEXT sr expertise rate
Rate the expertise of the primary ship repairer insurer on a
scale from 1 (excellent) to 5 (poor):
!
TEXT sr carrier rating
What is the Best's rating for the Ship Repairer underlying insurance?

!
TEXT small sr primary carrier
Is the surplus of the carrier for the Ship Repairer insurance small?
!
TEXT sr limit
What is the limit of the Ship Repairer underlying insurance?
!
TEXT sr premium
What is the premium for the Ship Repairer underlying insurance?
!
TEXT repair type
What type of repair does the applicant generally perform?
!
TEXT repair is potentially gas freeing
Is the type of ship repair the applicant generally performs potentially gas-freeing?
!
TEXT vessel type
On what type of vessel are the repairs generally performed?
!
TEXT sr work is for the government
Is the government a major client of the ship repairer?
!
TEXT more than 25 pct of work subcontracted on premises
Does a subcontractor perform more than 25% of the ship repair work on the applicant's premises?
!
TEXT hold harmless agreement exists with subcontractor
Does the ship repairer have a hold-harmless agreement with his subcontractor?
!
TEXT Best rating of subcontractors insurer is A or A plus
Is the Best's rating of the subcontractor's insurer A or A+?
!
TEXT applicant has a P and I policy
Does the applicant have P and I underlying insurance?
!
TEXT vo carrier
Select the carrier for the P & I primary insurance:
!
TEXT vo expertise rate
Rate the expertise of the primary P and I insurer on a scale from 1 (excellent) to 5 (poor):
!
TEXT vo carrier rating
What is the Best's rating for the P and I underlying insurance?
!
TEXT small vo primary carrier
Is the surplus of the carrier for the P and I insurance adequate?
!
TEXT vo limit
What is the limit of the P and I underlying insurance?
!
TEXT vo premium
What is the premium for the P and I underlying insurance?
!
TEXT MEL and ROW are covered
Does the applicant have coverage for Maritime Employer's Liability and Removal of Wreck?

!
TEXT P and I form is SP 38
Is the underlying P and I policy written on an SP-38 form?
!
TEXT cargo is covered
Does the applicant have cargo coverage?
!
TEXT cargo is owned
Does the applicant own the cargo?
!
TEXT limit extent
How would you describe the restriction on the P and I limit?
!
TEXT P and I covers excess RDC, towers
Does the P and I policy cover excess collision and
towers liability?
!
TEXT ctl
Which of the following determines the collision/towers limit:
!
TEXT total tugs
Enter the total number of tugs in the fleet:
!
TEXT number of crew on tug
Enter the average number of crew on the tugboats:
!
TEXT tow own barge
Does the applicant tow his own barges?
!
TEXT tug value
Enter the average value of the tugs:
!
TEXT special cargo
Does the tug tow any of the following?
!
TEXT tug cargo is hazardous
Is the tug cargo hazardous?
!
TEXT location is river
Does the applicant operate on a river?
!
TEXT tug age
Enter the average age of the tugs:
!
!TEXT last survey
! How many years has it been since applicant
! last surveyed his fleet?
!
TEXT dry barges
Enter the total number of barges carrying dry cargo:
!
TEXT liquid barges
Enter the total number of barges carrying liquid cargo:
!
TEXT liquid cargo is a pollutant or is hazardous
Is the liquid cargo a pollutant or hazardous?
!
TEXT barge value
Enter the average value of the barges:
!

TEXT barge cargo is owned
Does the applicant own the cargo which is
carried in the barge?
!
TEXT barge age
Enter the average age of the barges:
!
TEXT total crewsupply
Enter the total number of crewboats and supplyboats
the fleet:
!
TEXT number of crew on crewsupply
Enter the average number of crew on a crewboat or supplyboat:
!
TEXT crewsupply value
Enter the average value of a crewboat or supplyboat:
!
TEXT crewsupply age
Enter the average age of a crewboat or supplyboat:
!
TEXT boat is a tugsupply
Are there tug-supply boats in the fleet?
!
TEXT crewsupply horsepower
Enter the horsepower of the crewboat or supplyboat:
!
TEXT cs special cargo
Does the tug-supply tow any of the following?
!
TEXT cs cargo is hazardous
Is the cargo pulled by or carried on the tug-supply hazardous?
!
TEXT CGL form is claims made
Is the CGL policy written for claims-made coverage?
!
TEXT retro date less than three years
Is the retro date of the policy within three years
of the inception of the policy?
!
TEXT discovery period less than six months
Is the discovery period allowed by policy less than
six months?
!
TEXT CGL carrier
Select the carrier for the CGL primary insurance:
!
TEXT CGL expertise rate
Rate the expertise of the primary CGL insurer on a
scale from 1 (excellent) to 5 (poor):
!
TEXT CGL carrier rating
What is the Best's rating for the CGL insurance?
!
TEXT small CGL primary carrier
Is the surplus of the carrier for the CGL insurance adequate?
!
TEXT CGL limit
What is the limit of the CGL underlying insurance?
!
TEXT CGL premium

What is the premium for the CGL underlying insurance?
!
TEXT autos owned or leased
Does the applicant own or lease any autos,
trucks, or tractor/trailers?
!
TEXT owned autos
Enter the total number of owned or leased private passenger vehicles,
pick-ups, and vans.
!
TEXT owned trucks
Enter the number of owned or leased trucks:
!
TEXT owned tractors
Enter the number of owned or leased tractor/trailers:
!
TEXT auto cargo legal exposure
Does the applicant have an auto cargo legal exposure?
!
TEXT auto cargo is hazardous
Is the cargo hazardous?
!
TEXT cargo is explosive or flammable
Is the cargo explosive or flammable?
!
TEXT auto cargo is owned
Does the applicant own the cargo?
!
TEXT auto carrier
Select the carrier for the Auto primary insurance:
!
TEXT auto expertise rate
Rate the expertise of the primary Auto insurer on a
scale from 1 (excellent) to 5 (poor):
!
TEXT auto carrier rating
What is the Best's rating for the Auto insurance?
!
TEXT small auto primary carrier
Is the surplus of the carrier for the Auto insurance adequate?
!
TEXT auto limit
What is the limit of the Auto insurance?
!
TEXT auto premium
What is the premium for the Auto underlying insurance?
!
TEXT aircraft owned or leased
Does the applicant own or lease any aircraft?
!
TEXT owned aircraft
Enter the number of owned or leased aircraft:
!
TEXT number of seats
Enter the number of seats on the aircraft:
!
TEXT leased aircraft
Enter the number of chartered aircraft:
!
TEXT air carrier

Select the carrier for the Air primary insurance:

!

TEXT air expertise rate

Rate the expertise of the primary Air insurer on a scale from 1 (excellent) to 5 (poor):

!

TEXT air carrier rating

What is the Best's rating for the Air insurance?

!

TEXT small air primary carrier

Is the surplus of the carrier for the Air insurance adequate?

!

TEXT air limit

What is the limit of the Air insurance?

!

TEXT air premium

What is the premium for the Air underlying insurance?

!

TEXT wc expertise rate

Rate the expertise of the primary workman's comp insurer on a scale from 1 (excellent) to 5 (poor): .

!

TEXT wc carrier rating

What is the Best's rating for the Workmans Comp insurance?

!

TEXT small wc primary carrier

Is the surplus of the carrier for the Workmans Comp insurance adequate?

!

TEXT statutory limit for wc insurance

Is the limit for the workman's comp insurance statutory?

!

TEXT alternative suggestion exists

Do you have a suggestion for a premium which would be more appropriate for this applicant?

!

TEXT target premium

Enter the value of your suggested premium:

!

! - - - - -
! - D I S P L A Y S -
! - - - - -

!

DISPLAY make sure higher rate is not a trap

The broker's suggested premium is substantially higher than the premium I have suggested. Examine the applicant's case more closely, since there may be an exposure which the broker has not told us about and which I have not thought to ask about.

!

DISPLAY decline because of wc limit

The applicant is not insured up to the statutory limit for workman's comp insurance. Consider declining the umbrella coverage.

!

DISPLAY decline because of auto limit

The minimum amount of auto insurance which the applicant must have, given his auto risks, is
[auto min limit (9,0)]

The applicant is not insured up to this amount in his underlying insurance. Therefore,

decline the umbrella coverage.

!
DISPLAY decline because of air limit

The minimum amount of air insurance which the applicant must have, given his air risks, is
[required limit (9,0)]

The applicant is not insured up to this amount in his underlying insurance. Therefore, decline the umbrella coverage.

!
DISPLAY decline because of sr limit

The minimum amount of ship repairer legal liability insurance which the applicant must have is one million dollars.

The applicant is not insured up to this amount in his underlying insurance. Therefore, decline the umbrella coverage.

!
DISPLAY decline because of vo limit

The minimum amount of Protection and Indemnity insurance which the applicant must have is one million dollars.

The applicant is not insured up to this amount in his underlying insurance. Therefore, decline the umbrella coverage.

!
DISPLAY decline because of CGL limit

The minimum amount of Comprehensive General Liability insurance which the applicant must have is one million dollars.

The applicant is not insured up to this amount in his underlying insurance. Therefore, decline the umbrella coverage.

!
DISPLAY check auto exposure because input prem is high

Based on the number of vehicles the applicant owns or leases, the expected premium for the auto underlying insurance is

[auto estimate (9,0)]

Since the auto premium the applicant actually pays is much higher than this estimate, the auto exposure may actually be greater than that indicated by the number of vehicles which the applicant owns or leases.

!
DISPLAY check auto exposure because input prem is low

Based on the number of vehicles the applicant owns or leases, the expected premium for the auto underlying insurance is

[auto estimate (9,0)]

Since the auto premium the applicant actually pays is much lower than this estimate, the auto exposure may actually be less than that indicated by the number of vehicles which the applicant owns

or leases.

!

DISPLAY ff wreck removal

"Follow form" wreck removal, since Removal of Wreck is not covered in any policy. This will exclude wreck removal costs from the coverage of the umbrella.

!

DISPLAY ff cargo exclusion

Exclude cargo in the umbrella policy. The applicant does not own the cargo, and it is not covered either in a cargo policy or in the P&I policy.

!

DISPLAY cargo is not covered

Note that the applicant owns the cargo, but the cargo is not covered either in the P&I policy or in a cargo policy.

!

DISPLAY P and I does not cover xs RDC, investigate

The P and I policy does not cover collision losses once the limit for the collision policy has been reached. This is a rare situation, since the P and I usually does cover excess collision.

There may be no cause for alarm. However, the reason that the P and I does not cover excess collision may be important.

!

DISPLAY adjusted receipts results

The amount of receipts is sufficiently low to cause the calculated premium to fall below the rate-on-line. Therefore, the premium amount, based on the receipts, is the rate-on-line of

[rol (7, 0)]

!

DISPLAY receipts results

The following factors have affected the calculation of the premium based on a percent of receipts:

broker reln:	[brkr fac (4, 0)]
applic reln:	[asrd fac (4, 0)]
competition:	[comp fac (4, 0)]
rcpt credit:	[rec fac (4, 0)]
repair type:	[repair fac (4, 0)]
vessel type:	[vessel fac (4, 0)]
repair location:	[locn fac (4, 0)]
govt work:	[govt fac (4, 0)]
subcontracting:	[subk fac (4, 0)]

The base amt of receipts is 0.75%. This has been multiplied by the sum of the above percentages and by the annual receipts of [total receipts (10, 0)] dollars to produce a premium of [receipts quote (10 , 0)].

!

DISPLAY might decline coverage

Because the underlying insurance carrier is small, there is a large risk of loss if that carrier defaults.

Therefore, consider declining coverage
for the umbrella.

!

DISPLAY decline coverage

Because the underlying insurance carrier
has a bad Best's rating, there is a large
risk of loss if that carrier defaults.

Therefore, consider declining coverage
for the umbrella.

!

DISPLAY decline because of hazardous cargo

Since the applicant owns his auto cargo, and that
cargo is very hazardous, the amount of non-marine
risk is very large.

Since it is desirable to write premdominantly
marine risks in a marine liability umbrella, consider
declining the coverage.

!

DISPLAY guy is lying

The payroll amount of [input wet payroll (9, 0)]
does not adequately compensate the [num wet emps (6, 0)]
employees of the applicant.

The total payroll for shipboard employees has been
calculated to be [wet emp pyrl (9, 0)].

Notify the broker of this difference, if you wish.

!

DISPLAY use Marks form

Since the CGL underlying insurance is written on a
claims-made basis, use the "hybrid" bumbershoot form.

!

DISPLAY consider declining claims made

The CGL policy is on a claims-made basis, which means that
the insurer must pay losses when the assured files a claim,
regardless of when the accident actually occurred.

Therefore, exposures which existed previously, but which
no longer exist could potentially be covered by this policy.
The retro date determines how far in the past the accident
could have occurred in order to be covered by this policy.
The discovery period allows the assured to file a claim
after his coverage has ended, for a loss which occurred
during the term of this policy.

Since the retro date is more than three years in the past,
or the discovery period is more than six months, consider
declining the umbrella coverage because the risk exposure is
too unpredictable.

!

DISPLAY vo final results

The alternative premium calculations which have been
derived in this session are:

Percent of Payroll : [payroll quote (9, 0)]
Per Vessel Rate & Excess Underlying: [excess quote (9,0)]

!

DISPLAY sr final results

The alternative premium calculations which have been
derived in this session are:

Percent of Receipts:	[receipts quote (9, 0)]
Excess Underlying:	[excess quote (9,0)]

!

DISPLAY target is too low

The suggested premium is substantially lower than the premium
I suggested. I will not even bother to try to meet it.

!

DISPLAY make sure higher rate is not a trap

Before accepting the higher suggested premium for this
application, I recommend that you make sure that the higher
rate is not an indication that there is a large exposure
of which I am not aware.

!

DISPLAY target cannot be reached

Despite my attempts to reduce the premium, I have not
been able to reach the premium you suggested. However, I
have determined that a premium of [premium (9,0)] is acceptable.

!

DISPLAY target has been reached

I have been able to lower my premium to meet the premium
you suggested of [target premium (9,0)].

!

END

APPENDIX B

Form Definitions for the Graphical Interface of the Phase III Prototype


```
;;; -*- Mode: ART; Base: 10.; Package: ART-User -*-
```

```
(deffacts underwriter
  "Current drawer"
  (current-drawer bumbershoot))

(defschema bumbershoot
  "Bumbershoot drawer"
  (instance-of drawer)
  (title "MARINE UMBRELLA LIABILITY INSURANCE UNDERWRITER")
  (case-type "Applicant")
  (folder-scale 0.8)
  (header-ff-extent (15 100)))

(defschema gen-info-folder
  "General Info folder"
  (instance-of folder)
  (title "GENERAL INFORMATION")
  (header-title "GEN INFO")
  (in-drawer bumbershoot)
  (icon-title ("GENERAL" "INFORMATION"))
  (icon-coords (2 368))
  (header-icon-coords (20 78)))

(defschema primary-coverage-folder
  "Primary Coverage folder"
  (instance-of folder)
  (title "PRIMARY INSURANCE COVERAGE INFORMATION")
  (header-title "PRIM COVG")
  (in-drawer bumbershoot)
  (icon-title ("PRIMARY" "COVERAGE"))
  (icon-coords (173 246))
  (header-icon-coords (152 54)))

(defschema line-of-business-folder
  "Line of Business folder"
  (instance-of folder)
  (title "LINE OF APPLICANT'S BUSINESS")
  (header-title "BUS LINE")
  (in-drawer bumbershoot)
  (icon-title ("LINE OF" "BUSINESS"))
  (icon-coords (173 490))
  (header-icon-coords (152 102)))

(defschema endorsements-folder
  "Endorsements folder"
  (instance-of folder)
  (title "ENDORSEMENTS")
  (header-title "ENDORSMT")
  (in-drawer bumbershoot)
  (icon-title ("ENDORSEMNTS" " ")))
  (icon-coords (347 612))
  (header-icon-coords (296 126)))

(defschema standard-rates-folder
  "Standard rates folder"
  (instance-of folder)
  (title "STANDARD RATE RANGES")
  (header-title "STD RATES")
  (in-drawer bumbershoot)
  (icon-title ("STANDARD" "RATES"))
  (icon-coords (359 246))
  (header-icon-coords (306 54)))

(defschema credits-penalties-folder
  "Premium Credits and Penalties folder"
  (instance-of folder)
  (title "PREMIUM CREDITS AND PENALTIES")
  (header-title "CRED&PEN")
  (in-drawer bumbershoot)
  (icon-title ("CREDITS" "& PENALTIES"))
  (icon-coords (545 368))
  (header-icon-coords (450 78)))

;(defschema premium-calculation-folder
```

```
;      "Premium Calculation folder"
; (instance-of folder)
; (title "PREMIUM CALCULATIONS")
; (header-title "PREMIUM")
; (in-drawer bumbershoot)
; (icon-title ("PREMIUM" "CALCULATION"))
; (icon-coords (711 368))
; (header-icon-coords (582 78)))

(defschema policy-folder
  "Final Policy folder"
  (instance-of folder)
  (title "UMBRELLA POLICY")
  (header-title "POLICY")
  (in-drawer bumbershoot)
  (icon-title ("UMBRELLA" "POLICY"))
  (icon-coords (878 368))
  (header-icon-coords (714 78)))

(defschema connector-1
  "Connector from gen-info-folder to credits-penalties-folder"
  (instance-of connector)
  (folder-from gen-info-folder)
  (folder-to credits-penalties-folder))

(defschema connector-2
  "Connector from gen-info-folder to primary-coverage-folder"
  (instance-of connector)
  (folder-from gen-info-folder)
  (folder-to primary-coverage-folder)
  (drawer-configuration (13))
  (header-configuration (16)))

(defschema connector-3
  "Connector from gen-info-folder to line-of-business-folder"
  (instance-of connector)
  (folder-from gen-info-folder)
  (folder-to line-of-business-folder)
  (drawer-configuration (13))
  (header-configuration (16)))

(defschema connector-4
  "Connector from line-of-business-folder to credits-penalties-folder"
  (instance-of connector)
  (folder-from line-of-business-folder)
  (folder-to credits-penalties-folder)
  (drawer-configuration (14))
  (header-configuration (15)))

(defschema connector-5
  "Connector from line-of-business-folder to endorsements-folder"
  (instance-of connector)
  (folder-from line-of-business-folder)
  (folder-to endorsements-folder)
  (drawer-configuration (14))
  (header-configuration (15)))

(defschema connector-6
  "Connector from primary-coverage-folder to credits-penalties-folder"
  (instance-of connector)
  (folder-from primary-coverage-folder)
  (folder-to credits-penalties-folder)
  (drawer-configuration (14))
  (header-configuration (15)))

(defschema connector-7
  "Connector from primary-coverage-folder to endorsements-folder"
  (instance-of connector)
  (folder-from primary-coverage-folder)
  (folder-to endorsements-folder)
  (drawer-configuration (14))
  (header-configuration (15)))

(defschema connector-8
  "Connector from endorsements-folder to credits-penalties-folder"
  (instance-of connector)
```

```

(folder-from endorsements-folder)
(folder-to credits-penalties-folder)
(drawer-configuration (28))
(header-configuration (38)))

(defschema connector-9
  "Connector from endorsements-folder to policy-folder"
  (instance-of connector)
  (folder-from endorsements-folder)
  (folder-to policy-folder)
  (drawer-configuration (375))
  (header-configuration (302)))

(defschema connector-10
  "Connector from credits-penalties-folder to policy-folder"
  (instance-of connector)
  (folder-from credits-penalties-folder)
  (folder-to policy-folder))

; (defschema connector-11
;   "Connector from premium-calculation-folder to policy-folder"
;   (instance-of connector)
;   (folder-from premium-calculation-folder)
;   (folder-to policy-folder))

; (defschema connector-12
;   "Connector from premium-calculation-folder to standard-rates-folder"
;   (instance-of connector)
;   (folder-from premium-calculation-folder)
;   (folder-to standard-rates-folder)
;   (drawer-configuration (11 -330 -521))
;   (header-configuration (16 -46 -407)))

(defschema connector-13
  "Connector from standard-rates-folder to credits-penalties-folder"
  (instance-of connector)
  (folder-from standard-rates-folder)
  (folder-to credits-penalties-folder)
  (drawer-configuration (16))
  (header-configuration (16)))

(defschema applicant-gen-info-form
  "Applicant General Information Form"
  (instance-of form)
  (title "APPLICANT GENERAL INFORMATION")
  (icon-title ("APPLICANT" "GEN INFO"))
  (icon-coords (65 267))
  (in-folder gen-info-folder)
  (form-fields
    ((200 100 "(name applicant (?val ?src))" 1.0 (enter) string
      30 1 tr12 (50 100
        "1. Name of applicant"
        (6 1.0 1.0 1.0) tr12))
      (220 130 "(name broker (?val ?src))" 1.0 (enter) string
        30 1 tr12 (50 130
          "2. Name of broker"
          (6 1.0 1.0 1.0) tr12))
      (250 180 "(shiprepairer applicant (?val ?src))" 1.0 (check) string
        3 1 tr12 (100 180 "a. Ship Repairer" (6 1.0 1.0 1.0) tr12))
      (250 210 "(shipbuilder applicant (?val ?src))" 1.0 (check) string
        3 1 tr12 (100 210 "b. Ship Builder" (6 1.0 1.0 1.0) tr12))
      (250 240 "(charterer applicant (?val ?src))" 1.0 (check) string
        3 1 tr12 (100 240 "c. Charterer" (6 1.0 1.0 1.0) tr12))
      (250 270 "(wharfinger applicant (?val ?src))" 1.0 (check) string
        3 1 tr12 (100 270 "d. Wharfinger" (6 1.0 1.0 1.0) tr12))
      (250 300 "(stevedore applicant (?val ?src))" 1.0 (check) string
        3 1 tr12 (100 300 "e. Stevedore" (6 1.0 1.0 1.0) tr12))
      (250 330 "(warehouseman applicant (?val ?src))" 1.0 (check) string
        3 1 tr12 (100 330 "f. Warehouseman" (6 1.0 1.0 1.0) tr12))
      (200 400 "(gulf applicant (?val ?src))" 1.0 (check) string
        3 1 tr12 (100 400 "a. U.S. Gulf" (6 1.0 1.0 1.0) tr12))
      (200 430 "(river applicant (?val ?src))" 1.0 (check) string
        3 1 tr12 (100 430 "b. River" (6 1.0 1.0 1.0) tr12))
      (200 460 "(east applicant (?val ?src))" 1.0 (check) string
        3 1 tr12 (100 460 "c. East Coast" (6 1.0 1.0 1.0) tr12))
    ))

```

```

(200 490 "(other-loc applicant (?val ?src))" 1.0 (check) string
  3 1 tr12 (100 490 "d. Other" (6 1.0 1.0 1.0) tr12))
(300 560 "(boats applicant (?val ?src))" 1.0 (check) string
  3 1 tr12 (100 560 "a. Watercraft" (6 1.0 1.0 1.0) tr12))
(300 590 "(planes applicant (?val ?src))" 1.0 (check) string
  3 1 tr12 (100 590 "b. Aircraft" (6 1.0 1.0 1.0) tr12))
(300 620 "(cars applicant (?val ?src))" 1.0 (check) string
  3 1 tr12 (100 620 "c. Autos or Trucks" (6 1.0 1.0 1.0) tr12))
(800 130 "(wet-emp applicant (?val ?src))" 1.0 (enter) number
  6 0 tr12 (650 130
    "a. Shipboard: "
    (6 1.0 1.0 1.0) tr12))
(800 160 "(dry-emp applicant (?val ?src))" 1.0 (enter) number
  8 0 tr12 (650 160
    "b. Non-shipboard: "
    (6 1.0 1.0 1.0) tr12))
(800 230 "(wet-payroll applicant (?val ?src))" 1.0 (enter) number
  8 0 tr12 (650 230
    "a. Shipboard: "
    (6 1.0 1.0 1.0) tr12))
(800 260 "(dry-payroll applicant (?val ?src))" 1.0 (enter) number
  6 0 tr12 (650 260
    "b. Non-shipboard: "
    (6 1.0 1.0 1.0) tr12))
(800 300 "(receipts applicant (?val ?src))" 1.0 (enter) number
  10 0 tr12 (600 300
    "8. Annual receipts "
    (6 1.0 1.0 1.0) tr12))
(960 370 "(agg-losses applicant (?val ?src))" 1.0 (enter) number
  8 0 tr12 (650 370
    "a. Agg. losses > $25,000/year for past 5 years:"
    (6 1.0 1.0 1.0) tr12))
(960 400 "(big-losses applicant (?val ?src))" 1.0 (enter) string
  3 1 tr12 (650 400
    "b. Any losses > $100,000 in past 5 years? (Y/N):"
    (6 1.0 1.0 1.0) tr12))
(960 430 "(huge-losses applicant (?val ?src))" 1.0 (enter) string
  3 1 tr12 (650 430
    "c. Any losses > $250,000 in any year? (Y/N):"
    (6 1.0 1.0 1.0) tr12)))
(has-string (50 160 "3. Line of Business: "
  (6 1.0 1.0 1.0) tr12)
  (50 370 "4. Location: "
  (6 1.0 1.0 1.0) tr12)
  (50 530 "5. Does applicant own or lease any of the following: "
  (6 1.0 1.0 1.0) tr12)
  (600 100 "6. Number of employees "
  (6 1.0 1.0 1.0) tr12)
  (600 200 "7. Annual payroll"
  (6 1.0 1.0 1.0) tr12)
  (600 340 "9. Loss Record"
  (6 1.0 1.0 1.0) tr12)))

(defschema broker-relationship-form
  "Broker Relationship Form"
  (instance-of form)
  (title "BROKER RELATIONSHIP")
  (icon-title ("BROKER" "RELATIONSHIP"))
  (icon-coords (305 267))
  (in-folder gen-info-folder)
  (form-fields
    ((360 150 "(good broker (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 150 "a. Good" (6 1.0 1.0 1.0) tr12))
      (360 200 "(bad broker (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 200 "b. Bad" (6 1.0 1.0 1.0) tr12))
      (360 250 "(indifferent broker (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 250 "c. Indifferent" (6 1.0 1.0 1.0) tr12))
      (360 450 "(none broker (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 450 "a. None" (6 1.0 1.0 1.0) tr12))
      (360 500 "(marginal broker (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 500 "b. Marginal" (6 1.0 1.0 1.0) tr12))
      (360 550 "(substantial broker (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 550 "c. Substantial" (6 1.0 1.0 1.0) tr12))))
    (has-string (200 100 "1. Loss record on broker's book of business is:"
      (6 1.0 1.0 1.0) tr12))
    (has-string (200 400 "2. Amount of business of broker's office received:"

```

```

(6 1.0 1.0 1.0) tr12)))

(defschema applicant-relationship-form
  "Applicant Relationship Form"
  (instance-of form)
  (title "APPLICANT RELATIONSHIP")
  (icon-title ("APPLICANT" "RELATIONSHIP"))
  (icon-coords (545 267))
  (in-folder gen-info-folder)
  (form-fields
    ((360 150 "(good applicant (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 150 "a. Good" (6 1.0 1.0 1.0) tr12))
      (360 200 "(bad applicant (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 200 "b. Bad" (6 1.0 1.0 1.0) tr12))
      (360 250 "(indifferent applicant (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 250 "c. Indifferent" (6 1.0 1.0 1.0) tr12))
      (360 450 "(none applicant (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 450 "a. None" (6 1.0 1.0 1.0) tr12))
      (360 500 "(marginal applicant (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 500 "b. Marginal" (6 1.0 1.0 1.0) tr12))
      (360 550 "(substantial applicant (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 550 "c. Substantial" (6 1.0 1.0 1.0) tr12))))
    (has-string (200 100 "1. Loss record of applicant's account is:"
      (6 1.0 1.0 1.0) tr12))
    (has-string (200 400 "2. Amount of supporting business from applicant:"
      (6 1.0 1.0 1.0) tr12)))

(defschema renewal-info-form
  "Renewal Information Form"
  (instance-of form)
  (title "POLICY RENEWAL INFORMATION")
  (icon-title ("RENEWAL" "INFORMATION"))
  (icon-coords (785 267))
  (in-folder gen-info-folder)
  (form-fields
    ((360 150 "(good-renew applicant (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 150 "a. Good" (6 1.0 1.0 1.0) tr12))
      (360 200 "(bad-renew applicant (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 200 "b. Bad" (6 1.0 1.0 1.0) tr12))
      (360 250 "(indifferent-renew applicant (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 250 "c. Indifferent" (6 1.0 1.0 1.0) tr12))
      (450 350 "(premium-renew applicant (?val ?src))" 1.0 (enter) number
      9 0 tr12 (200 350
        "2. Premium on policy to renew:"
        (6 1.0 1.0 1.0) tr12))
      (550 450 "(years-renew applicant (?val ?src))" 1.0 (enter) number
      3 0 tr12 (200 450
        "3. Number of years applicant is a client:"
        (6 1.0 1.0 1.0) tr12))))
    (has-string (200 100 "1. Loss record on renewal policy is:"
      (6 1.0 1.0 1.0) tr12)))

(defschema vessel-owner-form
  "Vessel Owner Form; summary fields for schedule of vessels"
  (instance-of form)
  (title "VESSEL OWNER")
  (icon-title ("VESSEL" "OWNER"))
  (icon-coords (65 110))
  (in-folder line-of-business-folder)
  (form-fields
    ((300 170 "(tug-num vessel (?val ?src))" 1.0 (enter) number
      4 0 tr12 (150 170 "i. Number" (6 1.0 1.0 1.0) tr12))
      (300 200 "(tug-value vessel (?val ?src))" 1.0 (enter) number
      6 0 tr12 (150 200 "ii. Average value" (6 1.0 1.0 1.0) tr12))
      (300 230 "(tug-crew vessel (?val ?src))" 1.0 (enter) number
      4 0 tr12 (150 230 "iii. Average crew" (6 1.0 1.0 1.0) tr12))
      (300 300 "(l-barge-num vessel (?val ?src))" 1.0 (enter) number
      4 0 tr12 (150 300 "i. Number" (6 1.0 1.0 1.0) tr12))
      (300 330 "(l-barge-val vessel (?val ?src))" 1.0 (enter) number
      6 1 tr12 (150 330 "ii. Average value" (6 1.0 1.0 1.0) tr12))
      (300 400 "(d-barge-num vessel (?val ?src))" 1.0 (enter) number
      4 0 tr12 (150 400 "i. Number" (6 1.0 1.0 1.0) tr12))
      (300 430 "(d-barge-val vessel (?val ?src))" 1.0 (enter) number
      6 0 tr12 (150 430 "ii. Average value" (6 1.0 1.0 1.0) tr12))
      (300 500 "(cs-num vessel (?val ?src))" 1.0 (enter) number
      4 0 tr12 (150 500 "i. Number" (6 1.0 1.0 1.0) tr12))

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(300 530 "(cs-val vessel (?val ?src))" 1.0 (enter) number
  6 0 tr12 (150 530 "ii. Average value" (6 1.0 1.0 1.0) tr12))
(300 560 "(cs-crew vessel (?val ?src))" 1.0 (enter) number
  4 0 tr12 (150 560 "iii. Average crew" (6 1.0 1.0 1.0) tr12))
(300 630 "(good vessel (?val ?src))" 1.0 (check) string
  3 1 tr12 (150 630 "i. Good" (6 1.0 1.0 1.0) tr12))
(300 660 "(fair vessel (?val ?src))" 1.0 (check) string
  3 1 tr12 (150 660 "ii. Fair" (6 1.0 1.0 1.0) tr12))
(300 690 "(poor vessel (?val ?src))" 1.0 (check) string
  3 1 tr12 (150 690 "iii. Poor" (6 1.0 1.0 1.0) tr12))
(750 100 "(pollution vessel (?val ?src))" 1.0 (enter) string
  3 1 tr12 (500 100
    "2. Is pollution covered? (Y/N):"
    (6 1.0 1.0 1.0) tr12))
(860 200 "(p-and-i vessel (?val ?src))" 1.0 (enter) string
  3 1 tr12 (500 200
    "3. Is applicant covered by a P & I policy? (Y/N):"
    (6 1.0 1.0 1.0) tr12))
(950 300 "(r-o-w vessel (?val ?src))" 1.0 (enter) string
  3 1 tr12 (500 300
    "4. Does applicant have coverage for removal of wreck? (Y/N):"
    (6 1.0 1.0 1.0) tr12))
(750 450 "(hull-val-is-limit vessel (?val ?src))" 1.0 (check) string
  3 1 tr12 (550 450
    "a. Hull value"
    (6 1.0 1.0 1.0) tr12))
(750 500 "(coll-towers-is-limit vessel (?val ?src))" 1.0 (check) string
  3 1 tr12 (550 500
    "b. Collision/Towers limit"
    (6 1.0 1.0 1.0) tr12)))
(has-string (50 100 "1. Summary of schedule of vessels"
  (6 1.0 1.0 1.0) tr12))
(has-string (100 140 "a. Tugboats"
  (6 1.0 1.0 1.0) tr12))
(has-string (100 270 "b. Barges carrying liquid cargo"
  (6 1.0 1.0 1.0) tr12))
(has-string (100 370 "c. Barges carrying dry cargo"
  (6 1.0 1.0 1.0) tr12))
(has-string (100 470 "d. Crewboats and Supplyboats"
  (6 1.0 1.0 1.0) tr12))
(has-string (100 600 "e. Condition of vessels: "
  (6 1.0 1.0 1.0) tr12))
(has-string (500 400 "5. Limit of P&I insurance is:"
  (6 1.0 1.0 1.0) tr12)))

(defschema vessel-information-form
  "Vessel Information Form (schedule of vessels)"
  (instance-of form)
  (title "VESSEL INFORMATION")
  (icon-title ("VESSEL" "INFORMATION"))
  (icon-coords (305 110))
  (in-folder line-of-business-folder)
  (scheduled-by vessel)
  (new-schedule yes)
  (form-fields
    ((500 140 "(tug vessel (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 140 "a. Tugboat" (6 1.0 1.0 1.0) tr12))
    (500 180 "(barge vessel (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 180 "b. Barge" (6 1.0 1.0 1.0) tr12))
    (500 220 "(crewsupp vessel (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 220 "c. Crewboat/Supplyboat" (6 1.0 1.0 1.0) tr12))
    (500 260 "(fishboat vessel (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 260 "d. Fishboat/Blue Water/Semi-sub"
        (6 1.0 1.0 1.0) tr12))
    (500 300 "(sailboat vessel (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 300 "e. Sailboat/Yacht" (6 1.0 1.0 1.0) tr12))
    (450 350 "(crew vessel (?val ?src))" 1.0 (enter) number
      3 0 tr12 (200 350
        "2. Number of crew on vessel: "
        (6 1.0 1.0 1.0) tr12))
    (450 400 "(value vessel (?val ?src))" 1.0 (enter) number
      9 0 tr12 (200 400
        "3. Value of vessel: "
        (6 1.0 1.0 1.0) tr12))
    (450 450 "(age vessel (?val ?src))" 1.0 (enter) number
      9 0 tr12 (200 450

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"4. Age of vessel: "
(6 1.0 1.0 1.0) tr12))
(450 500 "(cargo vessel (?val ?src))" 1.0 (enter) string
3 1 tr12 (200 500
"5. Cargo is hazardous (Y/N):"
(6 1.0 1.0 1.0) tr12))
(450 550 "(ownership vessel (?val ?src))" 1.0 (enter) number
9 0 tr12 (200 550
"6. Cargo is owned (Y/N):"
(6 1.0 1.0 1.0) tr12)))
(has-string (200 100 "1. Type of Vessel: "
(6 1.0 1.0 1.0) tr12)))

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(defschema ship-repairer-form
  "Ship Repairer Form"
  (instance-of form)
  (title "SHIP REPAIRER")
  (icon-title ("SHIP" "REPAIRER"))
  (icon-coords (545 110))
  (in-folder line-of-business-folder)
  (form-fields
    ((400 100 "(rig repairer (?val ?src))" 1.0 (check) string
      3 1 tr12 (250 100 "a. Rigs" (6 1.0 1.0 1.0) tr12))
      (400 130 "(commercial repairer (?val ?src))" 1.0 (check) string
        3 1 tr12 (250 130 "b. Commercial" (6 1.0 1.0 1.0) tr12))
      (400 160 "(non-commercial repairer (?val ?src))" 1.0 (check) string
        3 1 tr12 (250 160 "c. Non-commercial" (6 1.0 1.0 1.0) tr12))
      (400 230 "(structural repairer (?val ?src))" 1.0 (check) string
        3 1 tr12 (250 230 "a. Structural" (6 1.0 1.0 1.0) tr12))
      (400 260 "(engine repairer (?val ?src))" 1.0 (check) string
        3 1 tr12 (250 260 "b. Engine/Propeller" (6 1.0 1.0 1.0) tr12))
      (500 300 "(govt repairer (?val ?src))" 1.0 (enter) string
        3 1 tr12 (200 300
          "3. Is the government a client? (Y/N) "
          (6 1.0 1.0 1.0) tr12))
          (530 340 "(subk repairer (?val ?src))" 1.0 (enter) string
            3 1 tr12 (200 340
              "4. Is the repair work subcontracted (Y/N)? "
              (6 1.0 1.0 1.0) tr12))
              (550 370 "(subk-hh repairer (?val ?src))" 0.0 (check) string
                3 1 tr12 (250 370 "a. There is a hold-harmless agreement "
                  (6 1.0 1.0 1.0) tr12))
                  (550 400 "(subk-insurer repairer (?val ?src))" 0.0 (enter) string
                    20 1 tr12 (250 400 "b. Insurer of the subcontractor: "
                      (6 1.0 1.0 1.0) tr12))
                      (550 430 "(subk-rating repairer (?val ?src))" 0.0 (enter) string
                        20 1 tr12 (250 430 "c. Best's rating of the insurer: "
                          (6 1.0 1.0 1.0) tr12))
                          (570 470 "(r-l-c repairer (?val ?src))" 1.0 (enter) string
                            3 1 tr12 (200 470 "5. Is there a Red Letter Clause in effect (Y/N)? "
                              (6 1.0 1.0 1.0) tr12))
                              (550 510 "(r-l-c-amt repairer (?val ?src))" 1.0 (enter) number
                                7 0 tr12 (250 510 "a. Amount of the Red Letter Clause:"
                                  (6 1.0 1.0 1.0) tr12))))
                                  (has-string (200 70 "1. Type of vessels repaired: "
                                    (6 1.0 1.0 1.0) tr12))
                                    (has-string (200 200 "2. Type of repairs performed: "
                                      (6 1.0 1.0 1.0) tr12)))

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(defschema ship-builder-form
  "Ship Builder Form"
  (instance-of form)
  (title "SHIP BUILDER")
  (icon-title ("SHIP" "BUILDER"))
  (icon-coords (785 110))
  (in-folder line-of-business-folder)
  (form-fields
    ((350 130 "(shipbuilder dummy (?val ?src))" 1.0 (enter) string
      3 1 tr12 (250 130 "Not Available" (6 1.0 1.0 1.0) tr12))))

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(defschema charterer-form
  "Charterer Form"
  (instance-of form)
  (title "CHARTERER")
  (icon-title ("CHARTERER" " "))
  (icon-coords (65 420))

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(in-folder line-of-business-folder)
(form-fields
  ((350 130 "(charterer dummy (?val ?src))" 1.0 (enter) string
    3 1 tr12 (250 130 "Not Available" (6 1.0 1.0 1.0) tr12))))))

(defschema wharfinger-form
  "Wharfinger Form"
  (instance-of form)
  (title "WHARFINGER")
  (icon-title ("WHARFINGER" " "))
  (icon-coords (305 420))
  (in-folder line-of-business-folder)
  (form-fields
    ((350 130 "(wharfinger dummy (?val ?src))" 1.0 (enter) string
      3 1 tr12 (250 130 "Not Available" (6 1.0 1.0 1.0) tr12))))))

(defschema stevedore-form
  "Stevedore Form"
  (instance-of form)
  (title "STEVEDORE")
  (icon-title ("STEVEDORE" " "))
  (icon-coords (545 420))
  (in-folder line-of-business-folder)
  (form-fields
    ((350 130 "(stevedore dummy (?val ?src))" 1.0 (enter) string
      3 1 tr12 (250 130 "Not Available" (6 1.0 1.0 1.0) tr12))))))

(defschema warehouseman-form
  "Warehouseman Form"
  (instance-of form)
  (title "WAREHOUSEMAN")
  (icon-title ("WAREHOUSEMAN" " "))
  (icon-coords (785 420))
  (in-folder line-of-business-folder)
  (form-fields
    ((350 130 "(warehouseman dummy (?val ?src))" 1.0 (enter) string
      3 1 tr12 (250 130 "Not Available" (6 1.0 1.0 1.0) tr12))))))

(defschema p-and-i-form
  "P & I Form"
  (instance-of form)
  (title "PROTECTION AND INDEMNITY")
  (icon-title ("PROTECTION AND" "INDEMNITY"))
  (icon-coords (25 267))
  (in-folder primary-coverage-folder)
  (form-fields
    ((300 100 "(limit p-and-i (?val ?src))" 1.0 (enter) number
      8 0 tr12 (200 100 "1. Limit" (6 1.0 1.0 1.0) tr12))
      (300 200 "(premium p-and-i (?val ?src))" 1.0 (enter) number
      8 0 tr12 (200 200 "2. Premium" (6 1.0 1.0 1.0) tr12))
      (300 300 "(carrier p-and-i (?val ?src))" 1.0 (enter) string
      30 1 tr12 (200 300 "3. Carrier" (6 1.0 1.0 1.0) tr12))))))

(defschema cgl-form
  "CGL Form"
  (instance-of form)
  (title "COMPREHENSIVE GENERAL LIABILITY")
  (icon-title ("COMPREHENSIVE" "GENL LIABILITY"))
  (icon-coords (225 267))
  (in-folder primary-coverage-folder)
  (form-fields
    ((300 100 "(limit cgl (?val ?src))" 1.0 (enter) number
      8 0 tr12 (200 100 "1. Limit" (6 1.0 1.0 1.0) tr12))
      (300 200 "(premium cgl (?val ?src))" 1.0 (enter) number
      8 0 tr12 (200 200 "2. Premium" (6 1.0 1.0 1.0) tr12))
      (300 300 "(carrier cgl (?val ?src))" 1.0 (enter) string
      30 1 tr12 (200 300 "3. Carrier" (6 1.0 1.0 1.0) tr12))
      (500 400 "(boat-excl cgl (?val ?src))" 1.0 (enter) string
      3 1 tr12 (200 400 "4. Watercraft exclusion deleted (Y/N)?"
        (6 1.0 1.0 1.0) tr12))
      (550 500 "(mel-covered cgl (?val ?src))" 1.0 (enter) string
      3 1 tr12 (200 500 "5. Is Maritime Employer's Liability covered (Y/N)?"
        (6 1.0 1.0 1.0) tr12))))))

(defschema air-form
  "Air Form"

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(instance-of form)
(title "AIR INSURANCE")
(icon-title ("AIR" "INSURANCE"))
(icon-coords (425 267))
(in-folder primary-coverage-folder)
(form-fields
  ((300 100 "(limit air (?val ?src))" 1.0 (enter) number
    8 0 tr12 (200 100 "1. Limit" (6 1.0 1.0 1.0) tr12))
    (300 200 "(premium air (?val ?src))" 1.0 (enter) number
    8 0 tr12 (200 200 "2. Premium" (6 1.0 1.0 1.0) tr12))
    (300 300 "(carrier air (?val ?src))" 1.0 (enter) string
    30 1 tr12 (200 300 "3. Carrier" (6 1.0 1.0 1.0) tr12))
    (550 400 "(planes-owned air (?val ?src))" 1.0 (enter) number
    4 0 tr12 (200 400 "4. Number of owned or leased aircraft:"
    (6 1.0 1.0 1.0) tr12))
    (500 500 "(num-seats air (?val ?src))" 1.0 (enter) number
    4 0 tr12 (200 500 "5. Number of seats on owned/leased aircraft:"
    (6 1.0 1.0 1.0) tr12))
    (500 600 "(planes-chartered air (?val ?src))" 1.0 (enter) number
    4 0 tr12 (200 600 "6. Number of chartered aircraft:"
    (6 1.0 1.0 1.0) tr12))))))

(defschema auto-form
  "Auto Form"
  (instance-of form)
  (title "AUTO INSURANCE")
  (icon-title ("AUTO" "INSURANCE"))
  (icon-coords (625 267))
  (in-folder primary-coverage-folder)
  (form-fields
    ((300 100 "(limit auto (?val ?src))" 1.0 (enter) number
      8 0 tr12 (200 100 "1. Limit" (6 1.0 1.0 1.0) tr12))
      (300 200 "(premium auto (?val ?src))" 1.0 (enter) number
      8 0 tr12 (200 200 "2. Premium" (6 1.0 1.0 1.0) tr12))
      (300 300 "(carrier auto (?val ?src))" 1.0 (enter) string
      30 1 tr12 (200 300 "3. Carrier" (6 1.0 1.0 1.0) tr12))
      (550 450 "(cars auto (?val ?src))" 1.0 (enter) number
      4 0 tr12 (250 450 "a. private passenger cars, pick-ups, vans"
      (6 1.0 1.0 1.0) tr12))
      (550 500 "(trucks auto (?val ?src))" 1.0 (enter) number
      4 0 tr12 (250 500 "b. trucks"
      (6 1.0 1.0 1.0) tr12))
      (550 550 "(tractors auto (?val ?src))" 1.0 (enter) number
      4 0 tr12 (250 550 "c. tractor/trailers"
      (6 1.0 1.0 1.0) tr12))
      (550 650 "(cargo auto (?val ?src))" 1.0 (enter) string
      3 1 tr12 (200 650 "4. Do vehicles carry hazardous cargo (Y/N)?"
      (6 1.0 1.0 1.0) tr12))))
    (has-string (200 400 "4. Number of owned or leased vehicles by type:"
    (6 1.0 1.0 1.0) tr12)))

(defschema workmans-comp-form
  "Workman's Compensation Insurance Form"
  (instance-of form)
  (title "WORKMAN'S COMPENSATION INSURANCE")
  (icon-title ("WORKMAN'S COMP" "INSURANCE"))
  (icon-coords (825 267))
  (in-folder primary-coverage-folder)
  (form-fields
    ((400 100 "(limit wc (?val ?src))" 1.0 (enter) string
      3 1 tr12 (200 100 "1. Is limit statutory (Y/N)?" (6 1.0 1.0 1.0) tr12))
      (300 200 "(carrier wc (?val ?src))" 1.0 (enter) string
      30 1 tr12 (200 200 "2. Carrier" (6 1.0 1.0 1.0) tr12))))))

; (defschema general-standard-rates-form
;   "standard rates used for multiple types of calculations"
;   (instance-of form)
;   (title "GENERAL STANDARD RATES")
;   (icon-title ("GENERAL" "STANDARD RATES"))
;   (icon-coords (65 267))
;   (in-folder standard-rates-folder)
;   (form-fields
;     ((500 100 "(competition standard-rates (?val ?src))" 1.0 (enter) number
;       2 0 tr12 (200 100
;         "1. Degree of competition: (1=high; 10=low)"
;         (6 1.0 1.0 1.0) tr12))

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; (350 140 "(comp-fac standard-rates (?val ?src))" 1.0 (enter) number
; 5 2 tr12 (200 140
; "2. Competition factor"
; (6 1.0 1.0 1.0) tr12))
; (350 180 "(renewal-comp-fac standard-rates (?val ?src))" 1.0 (enter)
; number 5 2 tr12 (200 180 "3. Competition factor for renewal policy"
; (6 1.0 1.0 1.0) tr12))
; (350 220 "(renewal-credit standard-rates (?val ?src))" 1.0 (enter)
; number 5 2 tr12 (200 220
; "4. Renewal credit"
; (6 1.0 1.0 1.0) tr12))))

; (defschema boat-rates-form
; "Base rates for per-vessel premium"
; (instance-of form)
; (title "VESSEL RATES")
; (icon-title ("VESSEL" "RATES"))
; (icon-coords (305 267))
; (in-folder standard-rates-folder)
; (form-fields
; ((300 100 "(tugs standard-rates (?val ?src))" 1.0 (enter) number
; 7 0 tr12 (200 100 "1. Tugs" (6 1.0 1.0 1.0) tr12))
; (300 130 "(barges standard-rates (?val ?src))" 1.0 (enter) number
; 7 0 tr12 (200 130 "2. Barges" (6 1.0 1.0 1.0) tr12))
; (350 160 "(crew-supply standard-rates (?val ?src))" 1.0 (enter) number
; 7 0 tr12 (200 160 "3. Crew/supply boats" (6 1.0 1.0 1.0) tr12)))))

; (defschema receipts-credit-form
; "credits for receipts volume"
; (instance-of form)
; (title "RECEIPTS CREDITS")
; (icon-title ("RECEIPTS" "CREDITS"))
; (icon-coords (545 267))
; (in-folder standard-rates-folder)
; (form-fields
; ((300 200 "(receipts-min-1 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (500 200 "(receipts-max-1 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (700 200 "(receipts-credit-1 standard-rates (?val ?src))" 1.0 (enter) number
; 5 2 tr12)
; (300 300 "(receipts-min-2 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (500 300 "(receipts-max-2 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (700 300 "(receipts-credit-2 standard-rates (?val ?src))" 1.0 (enter) number
; 5 2 tr12)
; (300 400 "(receipts-min-3 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (500 400 "(receipts-max-3 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (700 400 "(receipts-credit-3 standard-rates (?val ?src))" 1.0 (enter) number
; 5 2 tr12)
; (300 500 "(receipts-min-4 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (500 500 "(receipts-max-4 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (700 500 "(receipts-credit-4 standard-rates (?val ?src))" 1.0 (enter) number
; 5 2 tr12)
; (300 600 "(receipts-min-5 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (500 600 "(receipts-max-5 standard-rates (?val ?src))" 1.0 (enter) number
; 9 0 tr12)
; (700 600 "(receipts-credit-5 standard-rates (?val ?src))" 1.0 (enter) number
; 5 2 tr12)))
; (has-string (300 100 "MINIMUM" (6 1.0 1.0 1.0) tr12))
; (has-string (500 100 "MAXIMUM" (6 1.0 1.0 1.0) tr12))
; (has-string (700 100 "CREDIT" (6 1.0 1.0 1.0) tr12)))

; (defschema general-info-factors-form
; "Factors calculated from applicant general information"
; (instance-of form)
; (title "FACTORS CALCULATED FROM GENERAL INFORMATION")
; (icon-title ("GENERAL INFO" "FACTORS"))
; (icon-coords (65 267))
; (in-folder credits-penalties-folder)

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; (form-fields
;   ((450 100 "(loss-fac-b calculations (?val ?src))" 1.0 (enter) number
;     5 2 tr12 (200 100
;       "1. Broker loss factor"
;       (6 1.0 1.0 1.0) tr12))
;   (450 140 "(supporting-bus-fac-b calculations (?val ?src))" 1.0 (enter)
;     number 5 2 tr12 (200 140
;       "2. Broker supporting business factor"
;       (6 1.0 1.0 1.0) tr12))
;   (450 180 "(loss-fac-a calculations (?val ?src))" 1.0 (enter) number
;     5 2 tr12 (200 180 "3. Applicant loss factor"
;       (6 1.0 1.0 1.0) tr12))
;   (350 220 "(supporting-bus-fac-a calculations (?val ?src))" 1.0 (enter)
;     number 5 2 tr12 (200 220
;       "4. Applicant supporting business"
;       (6 1.0 1.0 1.0) tr12))
;   (450 260 "(location-fac calculations (?val ?src))" 1.0 (enter) number
;     5 2 tr12 (200 260
;       "5. Location factor"
;       (6 1.0 1.0 1.0) tr12))
;   (450 300 "(loss-fac-renewal calculations (?val ?src))" 1.0 (enter)
;     number 5 2 tr12 (200 300 "6. Loss factor on renewal policy"
;       (6 1.0 1.0 1.0) tr12))
;   (450 340 "(adjusted-wet-payroll calculations (?val ?src))" 1.0 (enter)
;     number 5 2 tr12 (200 340 "7. Adjusted shipboard payroll"
;       (6 1.0 1.0 1.0) tr12))))

; (defschema underlying-ins-factors-form
;   "Factors calculated from info on underlying insurance"
;   (instance-of form)
;   (title "FACTORS CALCULATED FROM UNDERLYING INSURANCE")
;   (icon-title ("U/L INSURANCE" "FACTORS"))
;   (icon-coords (305 267))
;   (in-folder credits-penalties-folder)
;   (form-fields
;     ((450 150 "(low-sr-limit-fac calculations (?val ?src))" 1.0 (enter) number
;       5 2 tr12 (250 150
;         "a. Low primary limit"
;         (6 1.0 1.0 1.0) tr12))
;     (450 200 "(sr-expertise-fac calculations (?val ?src))" 1.0 (enter) number
;       5 2 tr12 (250 200
;         "b. Carrier expertise"
;         (6 1.0 1.0 1.0) tr12))
;     (450 250 "(sr-prem-contribution calculations (?val ?src))" 1.0 (enter) number
;       9 0 tr12 (250 250
;         "c. Premium contribution"
;         (6 1.0 1.0 1.0) tr12))
;     (450 350 "(low-pi-limit-fac calculations (?val ?src))" 1.0 (enter) number
;       5 2 tr12 (250 350
;         "a. Low primary limit"
;         (6 1.0 1.0 1.0) tr12))
;     (450 400 "(pi-expertise-fac calculations (?val ?src))" 1.0 (enter) number
;       5 2 tr12 (250 400
;         "b. Carrier expertise"
;         (6 1.0 1.0 1.0) tr12))
;     (450 450 "(pi-prem-contribution calculations (?val ?src))" 1.0 (enter) number
;       9 0 tr12 (250 450
;         "c. Premium contribution"
;         (6 1.0 1.0 1.0) tr12))
;     (450 500 "(pi-limit-extent-fac calculations (?val ?src))" 1.0 (enter) number
;       5 2 tr12 (250 500
;         "d. Extent of P&I limit"
;         (6 1.0 1.0 1.0) tr12))))
;   (has-string (200 100 "1. Ship Repairer Underlying Insurance" (6 1.0 1.0 1.0) tr12))
;   (has-string (200 300 "2. Protection & Indemnity Underlying Insurance"
;     (6 1.0 1.0 1.0) tr12)))

; (defschema line-of-business-factors-form
;   "Factors calculated from info on line of business"
;   (instance-of form)
;   (title "FACTORS CALCULATED FROM BUSINESS EXPOSURES")
;   (icon-title ("LINE OF BUS" "FACTORS"))
;   (icon-coords (545 267))
;   (in-folder credits-penalties-folder)
;   (form-fields
;     ((450 150 "(repair-fac calculations (?val ?src))" 1.0 (enter) number

```

```

;      5 2 tr12 (250 150
;      "a. Type of repairs" (6 1.0 1.0 1.0) tr12))
;      (500 200 "(vessel-fac calculations (?val ?src))" 1.0 (enter) number
;      5 2 tr12 (250 200
;      "b. Type of vessels to repair" (6 1.0 1.0 1.0) tr12))
;      (450 250 "(govt-fac calculations (?val ?src))" 1.0 (enter) number
;      5 2 tr12 (250 250
;      "c. Repairs for the government" (6 1.0 1.0 1.0) tr12))
;      (450 300 "(subk-fac calculations (?val ?src))" 1.0 (enter) number
;      5 2 tr12 (250 300
;      "d. Repair work is subcontracted" (6 1.0 1.0 1.0) tr12))
;      (500 450 "(collision-fac calculations (?val ?src))" 1.0 (enter) number
;      5 2 tr12 (250 450
;      "a. Likelihood of collisions" (6 1.0 1.0 1.0) tr12))
;      (500 500 "(crew-contrib calculations (?val ?src))" 1.0 (enter) number
;      9 0 tr12 (250 500
;      "b. Tug crew contribution" (6 1.0 1.0 1.0) tr12))
;      (500 550 "(tug-haz-fac calculations (?val ?src))" 1.0 (enter) number
;      5 2 tr12 (250 550
;      "c. Hazardous cargo for tug" (6 1.0 1.0 1.0) tr12))
;      (500 600 "(tug-rig-fac calculations (?val ?src))" 1.0 (enter) number
;      5 2 tr12 (250 600
;      "d. Tug pulls rigs" (6 1.0 1.0 1.0) tr12)))
;      (has-string (200 100 "1. Ship Repairer" (6 1.0 1.0 1.0) tr12))
;      (has-string (200 400 "2. Vessel Owner" (6 1.0 1.0 1.0) tr12)))

(defschema premiums-form
  "Premiums calculated"
  (instance-of form)
  (title "PREMIUMS")
  (icon-title ("PREMIUMS" " "))
  (icon-coords (785 267))
  (in-folder credits-penalties-folder)
  (form-fields
    ((450 100 "(receipts-based-prem calculations (?val ?src))" 1.0 (enter) number
      9 0 tr12 (200 100
        "1. Premium based on receipts"
        (6 1.0 1.0 1.0) tr12))
      (550 200 "(per-vessel-prem calculations (?val ?src))" 1.0 (enter) number
        9 0 tr12 (200 200
          "2. Per-vessel rate + excess underlying premium"
          (6 1.0 1.0 1.0) tr12))
      (450 300 "(payroll-based-prem calculations (?val ?src))" 1.0 (enter) number
        9 0 tr12 (200 300
          "3. Premium based on receipts"
          (6 1.0 1.0 1.0) tr12))
      (450 400 "(renewal-based-prem calculations (?val ?src))" 1.0 (enter) number
        9 0 tr12 (200 400
          "4. Premium based on previous premium"
          (6 1.0 1.0 1.0) tr12))))))

```

APPENDIX C

Schema Definitions and Inferencing Rules of the Phase III Prototype

```
;;; -*- Mode: ART; Base: 10.; Package: ART-User -*-

(def-viewpoint-levels (schedule merging nil))

(defconstant *na-number* -9999999999)

(defrelation ready-to-fire (?con ?rule))

(defrelation inter-folder-connector (?c))

(defrelation selected (?form ?par))

(defschema applicant
  "applicant information"
  (name)
  (shiprepairer)
  (shipbuilder)
  (charterer)
  (wharfinger)
  (stevedore)
  (warehouseman)
  (gulf)
  (river)
  (east)
  (other-loc)
  (boats)
  (planes)
  (cars)
  (property)
  (receipts)
  (wet-emps)
  (dry-emps)
  (wet-payroll)
  (dry-payroll)
  (big-losses)
  (huge-losses)
  (agg-losses)
  (good)
  (bad)
  (indifferent)
  (none)
  (marginal)
  (substantial)
  (good-renew)
  (bad-renew)
  (indifferent-renew)
  (premium-renew)
  (years-renew))

(defschema broker
  "broker information"
  (name)
  (good)
  (bad)
  (indifferent)
  (none)
  (marginal)
  (substantial)
  (loss-fac)
  (supporting-bus-fac))

(defschema vessel
  "Data for vessel schedule"
  (instance-of schedule-object)
  (type-name "Vessel")
  (tug)
  (barge)
  (crewsupp)
  (fishboat)
  (sailboat)
  (crew)
  (value)
  (age)
  (cargo)
  (ownership))
```

```
(tug-num)
(tug-value)
(tug-crew)
(l-barge-num)
(l-barge-val)
(d-barge-num)
(d-barge-val)
(cs-num)
(cs-val)
(cs-crew)
(good)
(fair)
(poor)
(pollution)
(p-and-i)
(r-o-w)
(hull-val-is-limit)
(coll-towers-is-limit))

(defschema repairer
  "Data for ship repairer"
  (rig)
  (commercial)
  (non-commercial)
  (structural)
  (engine)
  (govt)
  (subk)
  (subk-hh)
  (subk-insurer)
  (subk-rating)
  (r-l-c)
  (r-l-c-amt)
  (gas))

(defschema dummy
  "Dummy relation for forms which are not yet available"
  (shipbuilder)
  (charterer)
  (wharfinger)
  (stevedore)
  (warehouseman))

(defschema p-and-i
  "Data for P&I underlying insurance"
  (limit)
  (carrier)
  (premium))

(defschema cgl
  "Data for CGL underlying insurance"
  (limit)
  (carrier)
  (premium)
  (boat-excl)
  (mel-covered))

(defschema air
  "Data for Air underlying insurance"
  (limit)
  (carrier)
  (premium)
  (planes-owned)
  (num-seats)
  (planes-chartered))

(defschema auto
  "Data for Auto underlying insurance"
  (limit)
  (carrier)
  (premium)
  (cars)
  (trucks)
  (tractors)
  (cargo))
```

```

(defschema wc
  "Data for Workman's Comp underlying insurance"
  (limit)
  (carrier))

(defschema calculations
  "Factors calculated from input data which adjust base premium rate"
  (loss-fac-a)
  (loss-fac-b)
  (loss-fac-renewal)
  (supporting-bus-a)
  (supporting-bus-b)
  (renewal-based-prem)
  (payroll-based-prem)
  (per-vessel-prem)
  (receipts-based-prem)
  (location-fac)
  (receipts-credit)
  (adjusted-wet-payroll)
  (sum-reln-factors)
  (low-sr-limit-fac)
  (sr-expertise-fac)
  (govt-fac)
  (subk-fac)
  (repair-fac)
  (vessel-fac)
  (sr-prem-contribution)
  (low-pi-limit-fac)
  (pi-expertise-fac)
  (pi-prem-contribution)
  (pi-limit-extent-fac)
  (collision-fac)
  (crew-contrib)
  (tug-haz-fac)
  (tug-rig-fac))

(defschema standard-rates
  (competition)
  (comp-fac)
  (renewal-comp-fac)
  (renewal-credit)
  (receipts-min-1)
  (receipts-min-2)
  (receipts-min-3)
  (receipts-min-4)
  (receipts-min-5)
  (receipts-max-1)
  (receipts-max-2)
  (receipts-max-3)
  (receipts-max-4)
  (receipts-max-5)
  (receipts-credit-1)
  (receipts-credit-2)
  (receipts-credit-3)
  (receipts-credit-4)
  (receipts-credit-5)
  (emp-salary)
  (pct-of-payroll)
  (pct-of-sr-ul)
  (rate-on-line)
  (pct-of-receipts)
  (min-sr-limit)
  (acceptable-sr-limit)
  (tugs)
  (barges)
  (crew-supply))

(defrule start-general-preparation
  "Start general preparation"
  (declare (salience 100))
=>
  (sprout (assert (schedule single single))))

```



```
; Filling up the "databases"
```

```
(defrule competition-amt
  (schedule single single)
  =>
  (assert (competition standard-rates (8 i))
    (tugs standard-rates (750 i))
    (barges standard-rates (500 i))
    (crew-supply standard-rates (750 i))
    (receipts-min-1 standard-rates (0 i))
    (receipts-max-1 standard-rates (2500000 i))
    (receipts-credit-1 standard-rates {0 i})
    (receipts-min-2 standard-rates (2499999 i))
    (receipts-max-2 standard-rates (5000000 i))
    (receipts-credit-2 standard-rates (0.1 i))
    (receipts-min-3 standard-rates (4999999 i))
    (receipts-max-3 standard-rates (10000000 i))
    (receipts-credit-3 standard-rates (0.15 i))
    (receipts-min-4 standard-rates (9999999 i))
    (receipts-max-4 standard-rates (25000000 i))
    (receipts-credit-4 standard-rates (0.25 i))
    (receipts-min-5 standard-rates (24999999 i))
    (receipts-max-5 standard-rates (999999999 i))
    (receipts-credit-5 standard-rates (0.33 i))
    (pct-of-receipts standard-rates (0.0075 i))
    (pct-of-payroll standard-rates (0.03 i))
    (pct-of-sr-ul standard-rates (0.0075 i))
    (emp-salary standard-rates (20000 i))
    (acceptable-sr-limit standard-rates (500000 i))
    (min-sr-limit standard-rates (1000000 i))
    (rate-on-line standard-rates (10000 i))))
```

```
; Broker loss factor (good)
```

```
(defrule broker-loss-fac-1-ready-to-fire
  (logical (good broker ("X" ?src)))
  =>
  (modify (schema broker
    (bad (" " ?src))
    (indifferent (" " ?src))))
  (assert (ready-to-fire (connector-1) broker-loss-fac-1)))
```

```
(defrule broker-loss-fac-1-firing
  "calculation of broker loss record factor"
  (good broker ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) broker-loss-fac-1)
  (inter-folder-connector connector-1)
  =>
  (assert (loss-fac-b calculations (5 =(min-src ?src))))
  (retract ?fact))
```

```
; Broker loss factor (bad)
```

```
(defrule broker-loss-fac-2-ready-to-fire
  (logical (bad broker ("X" ?src)))
  =>
  (modify (schema broker
    (good (" " ?src))
    (indifferent (" " ?src))))
  (assert (ready-to-fire (connector-1) broker-loss-fac-2)))
```

```
(defrule broker-loss-fac-2-firing
  "calculation of broker loss record factor"
  (bad broker ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) broker-loss-fac-2)
  (inter-folder-connector connector-1)
  =>
  (assert (loss-fac-b calculations (-10 =(min-src ?src))))
  (retract ?fact))
```

```
; Broker loss factor (indifferent)
```

```

(defrule broker-loss-fac-3-ready-to-fire
  (logical (indifferent broker ("X" ?src)))
  =>
  (modify (schema broker
    (good (" " ?src))
    (bad (" " ?src))))
  (assert (ready-to-fire (connector-1) broker-loss-fac-3)))

(defrule broker-loss-fac-3-firing
  "calculation of broker loss record factor"
  (indifferent broker ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) broker-loss-fac-3)
  (inter-folder-connector connector-1)
  =>
  (assert (loss-fac-b calculations (0 =(min-src ?src))))
  (retract ?fact))

; Broker supporting business factor (none)

(defrule broker-supporting-bus-fac-1-ready-to-fire
  (logical (none broker ("X" ?src)))
  =>
  (modify (schema broker
    (marginal (" " ?src))
    (substantial (" " ?src))))
  (assert (ready-to-fire (connector-1) broker-sup-bus-fac-1)))

(defrule broker-supporting-bus-fac-1-firing
  "calculation of broker supporting business factor"
  (none broker ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) broker-sup-bus-fac-1)
  (inter-folder-connector connector-1)
  =>
  (assert (supporting-bus-b calculations (-10 =(min-src ?src))))
  (retract ?fact))

; Broker supporting business factor (marginal)

(defrule broker-supporting-bus-fac-2-ready-to-fire
  (logical (marginal broker ("X" ?src)))
  =>
  (modify (schema broker
    (none (" " ?src))
    (substantial (" " ?src))))
  (assert (ready-to-fire (connector-1) broker-sup-bus-fac-2)))

(defrule broker-supporting-bus-fac-2-firing
  "calculation of broker supporting business factor"
  (marginal broker ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) broker-sup-bus-fac-2)
  (inter-folder-connector connector-1)
  =>
  (assert (supporting-bus-b calculations (-5 =(min-src ?src))))
  (retract ?fact))

; Broker supporting business factor (substantial)

(defrule broker-supporting-bus-fac-3-ready-to-fire
  (logical (substantial broker ("X" ?src)))
  =>
  (modify (schema broker
    (none (" " ?src))
    (marginal (" " ?src))))
  (assert (ready-to-fire (connector-1) broker-sup-bus-fac-3)))

(defrule broker-supporting-bus-fac-3-firing
  "calculation of broker supporting business factor"
  (substantial broker ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) broker-sup-bus-fac-3)
  (inter-folder-connector connector-1)
  =>
  (assert (supporting-bus-b calculations (-5 =(min-src ?src))))
  (retract ?fact))

; Applicant loss factor (good)

```

```

(defrule applicant-loss-fac-1-ready-to-fire
  (logical (good applicant ("X" ?src)))
  =>
  (modify (schema applicant
    (bad (" " ?src))
    (indifferent (" " ?src))))
  (assert (ready-to-fire (connector-1) applicant-loss-fac-1)))

(defrule applicant-loss-fac-1-firing
  "calculation of applicant loss record factor"
  (good applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) applicant-loss-fac-1)
  (inter-folder-connector connector-1)
  =>
  (assert (loss-fac-a calculations (5 =(min-src ?src))))
  (retract ?fact))

; Applicant loss factor (bad)

(defrule applicant-loss-fac-2-ready-to-fire
  (logical (bad applicant ("X" ?src)))
  =>
  (modify (schema applicant
    (good (" " ?src))
    (indifferent (" " ?src))))
  (assert (ready-to-fire (connector-1) applicant-loss-fac-2)))

(defrule applicant-loss-fac-2-firing
  "calculation of applicant loss record factor"
  (bad applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) applicant-loss-fac-2)
  (inter-folder-connector connector-1)
  =>
  (assert (loss-fac-a calculations (-10 =(min-src ?src))))
  (retract ?fact))

; Applicant loss factor (indifferent)

(defrule applicant-loss-fac-3-ready-to-fire
  (logical (indifferent applicant ("X" ?src)))
  =>
  (modify (schema applicant
    (good (" " ?src))
    (bad (" " ?src))))
  (assert (ready-to-fire (connector-1) applicant-loss-fac-3)))

(defrule applicant-loss-fac-3-firing
  "calculation of applicant loss record factor"
  (indifferent applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) applicant-loss-fac-3)
  (inter-folder-connector connector-1)
  =>
  (assert (loss-fac-a calculations (0 =(min-src ?src))))
  (retract ?fact))

; Applicant supporting business factor (none)

(defrule applicant-supporting-bus-fac-1-ready-to-fire
  (logical (none applicant ("X" ?src)))
  =>
  (modify (schema applicant
    (marginal (" " ?src))
    (substantial (" " ?src))))
  (assert (ready-to-fire (connector-1) applicant-sup-bus-fac-1)))

(defrule applicant-supporting-bus-fac-1-firing
  "calculation of applicant supporting business factor"
  (none applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) applicant-sup-bus-fac-1)
  (inter-folder-connector connector-1)
  =>
  (assert (supporting-bus-a calculations (-10 =(min-src ?src))))
  (retract ?fact))

; Applicant supporting business factor (marginal)

```

```

(defrule applicant-supporting-bus-fac-2-ready-to-fire
  (logical (marginal applicant ("X" ?src)))
  =>
  (modify (schema applicant
    (none (" " ?src))
    (substantial (" " ?src))))
  (assert (ready-to-fire (connector-1) applicant-sup-bus-fac-2)))

(defrule applicant-supporting-bus-fac-2-firing
  "calculation of applicant supporting business factor"
  (marginal applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) applicant-sup-bus-fac-2)
  (inter-folder-connector connector-1)
  =>
  (assert (supporting-bus-a calculations (-5 =(min-src ?src))))
  (retract ?fact))

; Applicant supporting business factor (substantial)

(defrule applicant-supporting-bus-fac-3-ready-to-fire
  (logical (substantial applicant ("X" ?src)))
  =>
  (modify (schema applicant
    (none (" " ?src))
    (marginal (" " ?src))))
  (assert (ready-to-fire (connector-1) applicant-sup-bus-fac-3)))

(defrule applicant-supporting-bus-fac-3-firing
  "calculation of applicant supporting business factor"
  (substantial applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) applicant-sup-bus-fac-3)
  (inter-folder-connector connector-1)
  =>
  (assert (supporting-bus-a calculations (-5 =(min-src ?src))))
  (retract ?fact))

; If applicant is not a shiprepairer, invalidate shiprepairer form

(defrule line-of-business-ready-to-fire
  (logical (shiprepairer applicant (" " ?src)))
  =>
  (assert (ready-to-fire (connector-3) line-of-business)))

(defrule line-of-business-firing
  (logical (shiprepairer applicant (" " ?src)))
  ?fact <- (ready-to-fire (connector-3) line-of-business)
  (inter-folder-connector connector-3)
  =>
  (assert (commercial repairer ("N/A" =(min-src ?src)))
    (non-commercial repairer ("N/A" =(min-src ?src)))
    (structural repairer ("N/A" =(min-src ?src)))
    (engine repairer ("N/A" =(min-src ?src)))
    (govt repairer ("N/A" =(min-src ?src)))
    (subk repairer ("N/A" =(min-src ?src)))
    (subk-hh repairer ("N/A" =(min-src ?src)))
    (subk-insurer repairer ("N/A" =(min-src ?src)))
    (r-l-c repairer ("N/A" =(min-src ?src)))
    (r-l-c-amt repairer (= *na-number* =(min-src ?src))))
  (retract ?fact))

; Line of business is not mutually exclusive

(defrule shiprepairer-selected-setup
  (logical (shiprepairer applicant ("X" ?src)))
  =>
  (assert (selected app-gen-info-form line-of-business)))

(defrule shiprepairer-selected-check
  (selected app-gen-info-form line-of-business)
  (not (shiprepairer applicant ?))
  =>
  (assert (shiprepairer applicant (" " i))))

(defrule shipbuilder-selected-setup
  (logical (shipbuilder applicant ("X" ?src)))
  =>

```

```

(assert (selected app-gen-info-form line-of-business)))

(defrule shipbuilder-selected-check
  (selected app-gen-info-form line-of-business)
  (not (shipbuilder applicant ?))
  =>
  (assert (shipbuilder applicant (" " i))))

(defrule charterer-selected-setup
  (logical (charterer applicant ("X" ?src)))
  =>
  (assert (selected app-gen-info-form line-of-business)))

(defrule charterer-selected-check
  (selected app-gen-info-form line-of-business)
  (not (charterer applicant ?))
  =>
  (assert (charterer applicant (" " i))))

(defrule wharfinger-selected-setup
  (logical (wharfinger applicant ("X" ?src)))
  =>
  (assert (selected app-gen-info-form line-of-business)))

(defrule wharfinger-selected-check
  (selected app-gen-info-form line-of-business)
  (not (wharfinger applicant ?))
  =>
  (assert (wharfinger applicant (" " i))))

(defrule stevedore-selected-setup
  (logical (stevedore applicant ("X" ?src)))
  =>
  (assert (selected app-gen-info-form line-of-business)))

(defrule stevedore-selected-check
  (selected app-gen-info-form line-of-business)
  (not (stevedore applicant ?))
  =>
  (assert (stevedore applicant (" " i))))

(defrule warehouseman-selected-setup
  (logical (warehouseman applicant ("X" ?src)))
  =>
  (assert (selected app-gen-info-form line-of-business)))

(defrule warehouseman-selected-check
  (selected app-gen-info-form line-of-business)
  (not (warehouseman applicant ?))
  =>
  (assert (warehouseman applicant (" " i))))

; Location of applicant's business

(defrule location-factor-1-ready-to-fire
  (logical (gulf applicant ("X" ?src)))
  =>
  (modify (schema applicant
    (east (" " ?src))
    (river (" " ?src))
    (other-loc (" " ?src))))
  (assert (ready-to-fire (connector-1) location-factor-1)))

(defrule location-factor-1-firing
  (gulf applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) location-factor-1)
  (inter-folder-connector connector-1)
  =>
  (assert (location-fac calculations (-10 =(min-src ?src))))
  (retract ?fact))

(defrule location-factor-2-ready-to-fire
  (logical (east applicant ("X" ?src)))
  =>
  (modify (schema applicant
    (gulf (" " ?src))

```

```

    (river (" " ?src))
    (other-loc (" " ?src))))
(assert (ready-to-fire (connector-1) location-factor-2)))

(defrule location-factor-2-firing
  (east applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) location-factor-2)
  (inter-folder-connector connector-1)
=>
  (assert (location-fac calculations (0 =(min-src ?src))))
  (retract ?fact))

(defrule location-factor-3-ready-to-fire
  (logical (river applicant ("X" ?src)))
=>
  (modify (schema applicant
    (gulf (" " ?src))
    (east (" " ?src))
    (other-loc (" " ?src))))
  (assert (ready-to-fire (connector-1) location-factor-3)))

(defrule location-factor-3-firing
  (river applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) location-factor-3)
  (inter-folder-connector connector-1)
=>
  (assert (location-fac calculations (-400 =(min-src ?src))))
  (retract ?fact))

(defrule location-factor-4-ready-to-fire
  (logical (other-loc applicant ("X" ?src)))
=>
  (modify (schema applicant
    (gulf (" " ?src))
    (east (" " ?src))
    (river (" " ?src))))
  (assert (ready-to-fire (connector-1) location-factor-4)))

(defrule location-factor-4-firing
  (other-loc applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) location-factor-4)
  (inter-folder-connector connector-1)
=>
  (assert (location-fac calculations (-400 =(min-src ?src))))
  (retract ?fact))

; Applicant renewal loss factor (good)

(defrule renewal-loss-fac-1-ready-to-fire
  (logical (good-renew applicant ("X" ?src)))
=>
  (modify (schema applicant
    (bad-renew (" " ?src))
    (indifferent-renew (" " ?src))))
  (assert (ready-to-fire (connector-1) renewal-loss-fac-1)))

(defrule renewal-loss-fac-1-firing
  "calculation of applicant loss record factor"
  (good-renew applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) renewal-loss-fac-1)
  (inter-folder-connector connector-1)
=>
  (assert (loss-fac-renewal calculations (5 =(min-src ?src))))
  (retract ?fact))

; Applicant renewal loss factor (bad)

(defrule renewal-loss-fac-2-ready-to-fire
  (logical (bad-renew applicant ("X" ?src)))
=>
  (modify (schema applicant
    (good-renew (" " ?src))
    (indifferent-renew (" " ?src))))
  (assert (ready-to-fire (connector-1) renewal-loss-fac-2)))

(defrule renewal-loss-fac-2-firing

```

```

    "calculation of applicant loss record factor"
    (bad-renew applicant ("X" ?src))
    ?fact <- (ready-to-fire (connector-1) renewal-loss-fac-2)
    (inter-folder-connector connector-1)
    =>
    (assert (loss-fac-renewal calculations (-10 =(min-src ?src))))
    (retract ?fact))

; Applicant renewal loss factor (indifferent)

(defrule renewal-loss-fac-3-ready-to-fire
  (logical (indifferent-renew applicant ("X" ?src)))
  =>
  (modify (schema applicant
    (good (" " ?src))
    (bad (" " ?src))))
  (assert (ready-to-fire (connector-1) renewal-loss-fac-3)))

(defrule renewal-loss-fac-3-firing
  "calculation of applicant loss record factor"
  (indifferent-renew applicant ("X" ?src))
  ?fact <- (ready-to-fire (connector-1) renewal-loss-fac-3)
  (inter-folder-connector connector-1)
  =>
  (assert (loss-fac-renewal calculations (0 =(min-src ?src))))
  (retract ?fact))

; translating competition (betw 1 and 10) to a percent (betw -25 and 33)

(defrule convert-competition-1
  (logical (competition standard-rates (?comp & : (?comp < 5) ?src-comp)))
  =>
  (assert (comp-fac standard-rates
    ((25 - (?comp * 5)) =(min-src ?src-comp)))
    (renewal-comp-fac standard-rates (0.333 =(min-src ?src-comp)))
    (renewal-credit standard-rates (0.15 =(min-src ?src-comp)))))

(defrule convert-competition-2
  (logical (competition standard-rates (?comp & : (?comp > 5) ?src-comp)))
  =>
  (assert (comp-fac standard-rates
    ((-7 * (?comp - 5)) =(min-src ?src-comp)))
    (renewal-comp-fac standard-rates (-0.333 =(min-src ?src-comp)))
    (renewal-credit standard-rates (-0.25 =(min-src ?src-comp)))))

(defrule convert-competition-3
  (logical (competition standard-rates (5 ?src-comp)))
  =>
  (assert (comp-fac standard-rates (0 =(min-src ?src-comp)))
    (renewal-comp-fac standard-rates (0 =(min-src ?src-comp)))
    (renewal-credit standard-rates (-0.25 =(min-src ?src-comp)))))

;This is a new section

(defrule renewal-based-premium-ready-to-fire
  (logical (premium-renew applicant (?pp ?pp-src))
    (renewal-credit standard-rates (?rc ?rc-src))
    (renewal-comp-fac standard-rates (?rcf ?rcf-src)))
  =>
  (assert (ready-to-fire (connector-1 connector-13) renewal-based-premium)))

(defrule renewal-based-premium-firing
  "calculation of premium based on previous year's premium"
  (logical (premium-renew applicant (?pp ?pp-src))
    (renewal-credit standard-rates (?rc ?rc-src))
    (renewal-comp-fac standard-rates (?rcf ?rcf-src)))
  ?fact <- (ready-to-fire (connector-1 connector-13) renewal-based-premium)
  (inter-folder-connector connector-1 | connector-13)
  =>
  (assert (renewal-based-prem calculations
    ((=?pp * ((1 - ?rc) + (abs ?rc) * ?rcf))
    =(min-src ?pp-src ?rc-src ?rcf-src))))
  (retract ?fact))

(defrule receipts-credit-calc-ready-to-fire
  (logical (receipts applicant (?rec ?rec-src))

```

```

(case ((and (receipts-min-1 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
            (receipts-max-1 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
            (receipts-credit-1 standard-rates (?rcr ?rcr-src))))
      ((and (receipts-min-2 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
            (receipts-max-2 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
            (receipts-credit-2 standard-rates (?rcr ?rcr-src))))
      ((and (receipts-min-3 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
            (receipts-max-3 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
            (receipts-credit-3 standard-rates (?rcr ?rcr-src))))
      ((and (receipts-min-4 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
            (receipts-max-4 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
            (receipts-credit-4 standard-rates (?rcr ?rcr-src))))
      ((and (receipts-min-5 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
            (receipts-max-5 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
            (receipts-credit-5 standard-rates (?rcr ?rcr-src)))))
=>
(assert (ready-to-fire (connector-1 connector-13) receipts-credit-calc)))

(defrule receipts-credit-calc-firing
  "calculation of credit for receipts volume"
  (logical (receipts applicant (?rec ?rec-src))
    (case ((and (receipts-min-1 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
                (receipts-max-1 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
                (receipts-credit-1 standard-rates (?rcr ?rcr-src))))
          ((and (receipts-min-2 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
                (receipts-max-2 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
                (receipts-credit-2 standard-rates (?rcr ?rcr-src))))
          ((and (receipts-min-3 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
                (receipts-max-3 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
                (receipts-credit-3 standard-rates (?rcr ?rcr-src))))
          ((and (receipts-min-4 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
                (receipts-max-4 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
                (receipts-credit-4 standard-rates (?rcr ?rcr-src))))
          ((and (receipts-min-5 standard-rates (?rmn & :(?rmn < ?rec) ?rmn-src))
                (receipts-max-5 standard-rates (?rmx & :(?rmx > ?rec)?rmx-src))
                (receipts-credit-5 standard-rates (?rcr ?rcr-src)))))
    ?fact <- (ready-to-fire (connector-1 connector-13) receipts-credit-calc)
    (inter-folder-connector connector-1 | connector-13)
  =>
  (assert (receipts-credit calculations
    (?rcr =(min-src ?rec-src ?rmn-src ?rmx-src))))
  (retract ?fact))

(defrule check-payroll-input-ready-to-fire
  (logical (wet-emps applicant (?we ?we-src))
    (wet-payroll applicant (?wp ?wp-src))
    (emp-salary standard-rates (?es ?es-src)))
  =>
  (assert (ready-to-fire (connector-1 connector-13) check-payroll-input)))

(defrule check-payroll-input-firing
  "adjustment of employee payroll based on number of emps"
  (logical (wet-emps applicant (?we ?we-src))
    (wet-payroll applicant (?wp ?wp-src))
    (emp-salary standard-rates (?es ?es-src)))
  ?fact <- (ready-to-fire (connector-1 connector-13) check-payroll-input)
  (inter-folder-connector connector-1 | connector-13)
  =>
  (modify (schema calculations
    (adjusted-wet-payroll (=(max ?wp (?we * ?es))
      =(min-src ?we-src ?wp-src ?es-src))))
    (retract ?fact))

(defrule collect-factors
  (logical (loss-fac-a calculations (?lfa ?lfa-src))
    (supporting-bus-a calculations (?sbfa ?sbfa-src))
    (loss-fac-b calculations (?lfb ?lfb-src))
    (supporting-bus-b calculations (?sbfb ?sbfb-src))
    (comp-fac standard-rates (?cf ?cf-src)))
  =>
  (assert (sum-reln-factors calculations
    (=(+ ?lfa ?sbfa ?lfb ?sbfb ?cf)
      =(min-src ?lfa-src ?sbfa-src ?lfb-src ?sbfb-src ?cf-src)))))

(defrule payroll-based-prem-1-ready-to-fire
  (logical (boats applicant ("X" ?b-src))

```



```

      (adjusted-wet-payroll calculations (?awp ?awp-src))
      (sum-reln-factors calculations (?srfac ?srfac-src))
      (pct-of-payroll standard-rates (?pop ?pop-src)))
=>
(assert (ready-to-fire (connector-1 connector-13) payroll-based-prem-1)))

(defrule payroll-based-prem-1-firing
  "calculation of premium based on shipboard payroll"
  (logical (boats applicant ("X" ?b-src))
    (adjusted-wet-payroll calculations (?awp ?awp-src))
    (sum-reln-factors calculations (?srfac ?srfac-src))
    (pct-of-payroll standard-rates (?pop ?pop-src)))
  ?fact <- (ready-to-fire (connector-1 connector-13) payroll-based-prem-1)
  (inter-folder-connector connector-1 | connector-13)
=>
(assert (payroll-based-prem calculations (=?awp * ?pop * (1 - ?srfac))
      =(min-src ?awp-src ?srfac-src ?pop-src))))
(retract ?fact))

(defrule payroll-based-prem-2-ready-to-fire
  (logical (boats applicant (" " ?b-src)))
=>
(assert (ready-to-fire (connector-1) payroll-based-prem-2)))

(defrule payroll-based-prem-2-firing
  "premium based on shipboard payroll is not applicable"
  (logical (boats applicant (" " ?src)))
  ?fact <- (ready-to-fire (connector-1) payroll-based-prem-2)
  (inter-folder-connector connector-1)
=>
(assert (payroll-based-prem calculations (=na-number* =(min-src ?src))))
(retract ?fact))

(defrule receipts-based-prem-1-ready-to-fire
  (logical (shiprepairer applicant ("X" ?s-src))
    (receipts applicant (?rec ?rec-src))
    (sum-reln-factors calculations (?srfac ?srfac-src))
    (receipts-credit calculations (?rc ?rc-src))
    (repair-fac calculations (?rf ?rf-src))
    (vessel-fac calculations (?vf ?vf-src))
    (location-fac calculations (?lf ?lf-src))
    (govt-fac calculations (?gf ?gf-src))
    (subk-fac calculations (?sf ?sf-src))
    (pct-of-receipts standard-rates (?por ?por-src)))
=>
(assert (ready-to-fire (connector-1 connector-13) receipts-based-prem-1)))

(defrule receipts-based-prem-1-firing
  "calculation of premium based on receipts for shiprepairers"
  (logical (shiprepairer applicant ("X" ?s-src))
    (receipts applicant (?rec ?rec-src))
    (sum-reln-factors calculations (?srfac ?srfac-src))
    (receipts-credit calculations (?rc ?rc-src))
    (repair-fac calculations (?rf ?rf-src))
    (vessel-fac calculations (?vf ?vf-src))
    (location-fac calculations (?lf ?lf-src))
    (govt-fac calculations (?gf ?gf-src))
    (subk-fac calculations (?sf ?sf-src))
    (pct-of-receipts standard-rates (?por ?por-src)))
  ?fact <- (ready-to-fire (connector-1 connector-13) receipts-based-prem-1)
  (inter-folder-connector connector-1 | connector-13)
=>
(assert (receipts-based-prem calculations
  (=?rec * ?por * (1 - (+ ?srfac ?rc ?rf ?vf ?lf ?gf ?sf)))
  =(min-src ?rec ?por ?srfac-src ?rc ?rf ?vf ?lf ?gf ?sf))))
(retract ?fact))

(defrule receipts-based-prem-2-ready-to-fire
  (logical (shiprepairer applicant (" " ?b-src)))
=>
(assert (ready-to-fire (connector-1) receipts-based-prem-2)))

(defrule receipts-based-prem-2-firing
  "premium based on receipts is not applicable"
  (logical (shiprepairer applicant (" " ?src)))
  ?fact <- (ready-to-fire (connector-1) receipts-based-prem-2)

```

```

(inter-folder-connector connector-1)
=>
(assert (receipts-based-prem calculations (=na-number* =(min-src ?src))))
(retract ?fact))

(defrule shiprepairer-limit-1-ready-to-fire
  (logical (shiprepairer applicant ("X" ?sr-src))
    (min-sr-limit standard-rates (?ml ?ml-src))
    (limit shiprepairer (?lim & : (?lim < ?ml) ?lim-src)))
=>
(assert (ready-to-fire (connector-1 connector-6 connector-13)
  shiprepairer-limit-1)))

; JACOB: need an error message here & stop evaluating the applicant

(defrule shiprepairer-limit-1-firing.
  "ship repairer underlying insurance limit is unacceptably low"
  (logical (shiprepairer applicant ("X" ?sr-src))
    (min-sr-limit standard-rates (?ml ?ml-src))
    (limit shiprepairer (?lim & : (?lim < ?ml) ?lim-src)))
  ?fact <- (ready-to-fire (connector-1 connector-6 connector-13)
    shiprepairer-limit-1)
  (inter-folder-connector connector-1 | connector-6 | connector-13)
=>
  (modify (schema calculations
    (low-sr-limit-fac ( -1
      =(min-src ?sr-src ?ml-src ?lim-src)))
    (receipts-based-prem ( =na-number*
      =(min-src ?sr-src ?ml-src ?lim-src)))))
  (retract ?fact))

(defrule shiprepairer-limit-2-ready-to-fire
  (logical (shiprepairer applicant ("X" ?sr-src))
    (min-sr-limit standard-rates (?ml ?ml-src))
    (acceptable-sr-limit standard-rates (?asl ?asl-src))
    (limit shiprepairer
      (?lim & : (and (?lim >= ?ml) (?lim < ?asl)) ?lim-src)))
=>
(assert (ready-to-fire (connector-1 connector-6 connector-13)
  shiprepairer-limit-2)))

(defrule shiprepairer-limit-2-firing
  "limit of shiprepairer underlying insurance is low"
  (logical (shiprepairer applicant ("X" ?sr-src))
    (min-sr-limit standard-rates (?ml ?ml-src))
    (acceptable-sr-limit standard-rates (?asl ?asl-src))
    (limit shiprepairer
      (?lim & : (and (?lim >= ?ml) (?lim < ?asl)) ?lim-src)))
  ?fact <- (ready-to-fire (connector-1 connector-6 connector-13)
    shiprepairer-limit-2)
  (inter-folder-connector connector-1 | connector-6 | connector-13)
=>
  (modify (schema calculations
    (low-sr-limit-fac ( -0.5
      =(min-src ?sr-src ?ml-src ?asl-src ?lim-src)))))
  (retract ?fact))

(defrule shiprepairer-limit-3-ready-to-fire
  (logical (shiprepairer applicant ("X" ?sr-src))
    (acceptable-sr-limit standard-rates (?asl ?asl-src))
    (limit shiprepairer (?lim & : (?lim >= ?asl) ?lim-src)))
=>
(assert (ready-to-fire (connector-1 connector-6 connector-13)
  shiprepairer-limit-3)))

(defrule shiprepairer-limit-3-firing
  "limit of shiprepairer underlying insurance is adequate"
  (logical (shiprepairer applicant ("X" ?sr-src))
    (acceptable-sr-limit standard-rates (?asl ?asl-src))
    (limit shiprepairer (?lim & : (?lim >= ?asl) ?lim-src)))
  ?fact <- (ready-to-fire (connector-1 connector-6 connector-13)
    shiprepairer-limit-3)
  (inter-folder-connector connector-1 | connector-6 | connector-13)
=>
  (modify (schema calculations
    (low-sr-limit-fac ( 0

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                                =(min-src ?sr-src ?asl-src ?lim-src))))))
(retract ?fact))

(defrule sr-prem-contrib-ready-to-fire
  (logical (shiprepairer applicant ("X" ?sr-src))
    (sum-reln-factors calculations (?srfac ?srfac-src))
    (low-sr-limit-fac calculations (?lfac ?lfac-src))
    (pct-of-sr-ul standard-rates (?pos ?pos-src))
    (premium shiprepairer (?p ?p-src)))
  =>
  (assert (ready-to-fire (connector-1 connector-6 connector-13)
    sr-prem-contrib)))

(defrule sr-prem-contrib-firing
  "limit of shiprepairer underlying insurance is adequate"
  (logical (shiprepairer applicant ("X" ?sr-src))
    (sum-reln-factors calculations (?srfac ?srfac-src))
    (low-sr-limit-fac calculations (?lfac ?lfac-src))
    (pct-of-sr-ul standard-rates (?pos ?pos-src))
    (premium shiprepairer (?p ?p-src)))
  ?fact <- (ready-to-fire (connector-1 connector-6 connector-13)
    sr-prem-contrib)
  (inter-folder-connector connector-1 | connector-6 | connector-13)
  =>
  (assert (sr-prem-contribution calculations
    (=?p * ?pos *. (1 - (+ ?srfac ?lfac)))
    =(min-src ?p-src ?pos-src ?srfac-src ?lfac-src))))
  (retract ?fact))

(defrule repair-type-1-ready-to-fire
  (logical (structural repairer ("X" ?s-src))
    (not (engine repairer ("X" ?e-src))))
  =>
  (assert (ready-to-fire (connector-4) repair-type-1)))

(defrule repair-type-1-firing
  (logical (structural repairer ("X" ?s-src))
    (not (engine repairer ("X" ?e-src))))
  ?fact <- (ready-to-fire (connector-4) repair-type-1)
  (inter-folder-connector connector-4)
  =>
  (assert (repair-fac calculations (0 =(min-src ?s-src))))
  (retract ?fact))

(defrule repair-type-2-ready-to-fire
  (logical (not (structural repairer ("X" ?s-src))
    (engine repairer ("X" ?e-src))))
  =>
  (assert (ready-to-fire (connector-4) repair-type-2)))

(defrule repair-type-2-firing
  (logical (not (structural repairer ("X" ?s-src))
    (engine repairer ("X" ?e-src))))
  ?fact <- (ready-to-fire (connector-4) repair-type-2)
  (inter-folder-connector connector-4)
  =>
  (assert (repair-fac calculations (-0.05 =(min-src ?e-src))))
  (retract ?fact))

(defrule repair-type-3-ready-to-fire
  (logical (structural repairer ("X" ?s-src))
    (engine repairer ("X" ?e-src)))
  =>
  (assert (ready-to-fire (connector-4) repair-type-3)))

(defrule repair-type-3-firing
  (logical (structural repairer ("X" ?s-src))
    (engine repairer ("X" ?e-src)))
  ?fact <- (ready-to-fire (connector-4) repair-type-3)
  (inter-folder-connector connector-4)
  =>
  (assert (repair-fac calculations (-0.03 =(min-src ?s-src ?e-src))))
  (retract ?fact))

(defrule vessel-type-1-ready-to-fire
  (logical (rig repairer ("X" ?r-src)))

```

```

=>
(assert (ready-to-fire (connector-4) vessel-type-1))
(modify (schema repairer
  (commercial (" " =(min-src ?r-src)))
  (non-commercial (" " =(min-src ?r-src)))
  (gas ("N/A" =(min-src ?r-src)))))

(defrule vessel-type-1-firing
  (logical (rig repairer ("X" ?r-src)))
  (inter-folder-connector connector-4)
  ?fact <- (ready-to-fire (connector-4) vessel-type-1)
=>
  (assert (vessel-fac calculations (-0.5 =(min-src ?r-src))))
  (retract ?fact))

(defrule vessel-type-2-ready-to-fire
  (logical (non-commercial repairer ("X" ?r-src)))
=>
  (assert (ready-to-fire (connector-4) vessel-type-2))
  (modify (schema repairer
    (commercial (" " =(min-src ?r-src)))
    (rig (" " =(min-src ?r-src)))
    (gas ("N/A" =(min-src ?r-src)))))

(defrule vessel-type-2-firing
  (logical (non-commercial repairer ("X" ?r-src)))
  (inter-folder-connector connector-4)
  ?fact <- (ready-to-fire (connector-4) vessel-type-2)
=>
  (assert (vessel-fac calculations (0.10 =(min-src ?r-src))))
  (retract ?fact))

(defrule vessel-type-3-ready-to-fire
  (logical (commercial repairer ("X" ?r-src))
    (gas repairer ("N" ?g-src)))
=>
  (assert (ready-to-fire (connector-4) vessel-type-3))
  (modify (schema repairer
    (non-commercial (" " =(min-src ?r-src)))
    (rig (" " =(min-src ?r-src)))))

(defrule vessel-type-3-firing
  (logical (commercial repairer ("X" ?r-src))
    (gas repairer ("N" ?g-src)))
  (inter-folder-connector connector-4)
  ?fact <- (ready-to-fire (connector-4) vessel-type-3)
=>
  (assert (vessel-fac calculations (0 =(min-src ?r-src ?g-src))))
  (retract ?fact))

(defrule vessel-type-4-ready-to-fire
  (logical (commercial repairer ("X" ?r-src))
    (gas repairer ("Y" ?g-src)))
=>
  (assert (ready-to-fire (connector-4) vessel-type-4))
  (modify (schema repairer
    (non-commercial (" " =(min-src ?r-src)))
    (rig (" " =(min-src ?r-src)))))

(defrule vessel-type-4-firing
  (logical (commercial repairer ("X" ?r-src))
    (gas repairer ("Y" ?g-src)))
  (inter-folder-connector connector-4)
  ?fact <- (ready-to-fire (connector-4) vessel-type-4)
=>
  (assert (vessel-fac calculations (-0.15 =(min-src ?r-src ?g-src))))
  (retract ?fact))

(defrule govt-work-1-ready-to-fire
  (logical (govt repairer ("Y" ?g-src)))
=>
  (assert (ready-to-fire (connector-4) govt-work-1)))

(defrule govt-work-1-firing
  (logical (govt repairer ("Y" ?g-src)))
  (inter-folder-connector connector-4)

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```

?fact <- (ready-to-fire (connector-4) govt-work-1)
=>
(assert (govt-fac calculations (0.05 =(min-src ?g-src))))
(retract ?fact))

(defrule govt-work-2-ready-to-fire
(logical (govt repairer ("N" ?g-src)))
=>
(assert (ready-to-fire (connector-4) govt-work-2)))

(defrule govt-work-2-firing
(logical (govt repairer ("N" ?g-src)))
(inter-folder-connector connector-4)
?fact <- (ready-to-fire (connector-4) govt-work-2)
=>
(assert (govt-fac calculations (0 =(min-src ?g-src))))
(retract ?fact))

(defrule subcontractor-1-ready-to-fire
(logical (subk repairer ("N" ?s-src)))
=>
(assert (ready-to-fire (connector-4) subcontractor-1))
(modify (schema repairer
(subk-hh ("N/A" =(min-src ?s-src)))
(subk-insurer ("N/A" =(min-src ?s-src)))
(subk-rating ("N/A" =(min-src ?s-src))))))

(defrule subcontractor-1-firing
(logical (subk repairer ("N" ?s-src)))
(inter-folder-connector connector-4)
?fact <- (ready-to-fire (connector-4) subcontractor-1)
=>
(assert (subk-fac calculations (0 =(min-src ?s-src))))
(retract ?fact))

(defrule subcontractor-2-ready-to-fire
(logical (subk repairer ("Y" ?s-src))
(subk-hh repairer("Y" ?hh-src))
(or (subk-rating repairer ("A" ?r1-src))
(subk-rating repairer ("A+" ?r2-src))))
=>
(assert (ready-to-fire (connector-4) subcontractor-2)))

(defrule subcontractor-2-firing
(logical (subk repairer ("Y" ?s-src))
(subk-hh repairer("Y" ?hh-src))
(or (subk-rating repairer ("A" ?r1-src))
(subk-rating repairer ("A+" ?r2-src))))
(inter-folder-connector connector-4)
?fact <- (ready-to-fire (connector-4) subcontractor-2)
=>
(assert (subk-fac calculations (0 =(min-src ?s-src))))
(retract ?fact))

(defrule subcontractor-3-ready-to-fire
(logical (subk repairer ("Y" ?s-src))
(or (subk-hh repairer("N" ?hh-src))
(and (not (subk-rating repairer ("A" ?)))
(not (subk-rating repairer ("A+" ?))))))
=>
(assert (ready-to-fire (connector-4) subcontractor-3)))

(defrule subcontractor-3-firing
(logical (subk repairer ("Y" ?s-src))
(or (subk-hh repairer("N" ?hh-src))
(and (not (subk-rating repairer ("A" ?)))
(not (subk-rating repairer ("A+" ?))))))
(inter-folder-connector connector-4)
?fact <- (ready-to-fire (connector-4) subcontractor-3)
=>
(assert (subk-fac calculations (-0.10 =(min-src ?s-src))))
(retract ?fact))

; load database with broker information

(defrule dummy-broker-1

```

```

(logical (name broker ("Alexander & Alexander" ?b-src)))
=>
(assert (good broker ("X" i))
        (substantial broker ("X" i))))

(defrule dummy-applicant-1
(logical (name applicant ("Mark Blackman" ?a-src)))
=>
(assert (shiprepairer applicant ("X" i))
        (east applicant ("X" i))
        (receipts applicant (2900000 i))
        (wet-emp applicant (10 i))
        (dry-emp applicant (90 i))
        (wet-payroll applicant (200000 i))
        (dry-payroll applicant (3000000 i))
        (good applicant ("X" i))
        (boats applicant ("X" i))
        (substantial applicant ("X" i))
        (good-renew applicant ("X" i))
        (premium-renew applicant (200000 i))
        (years-renew applicant (5 i))
        (commercial repairer ("X" i))
        (structural repairer ("X" i))
        (govt repairer ("Y" i))
        (subk repairer ("Y" i))
        (subk-hh repairer ("Y" i))
        (subk-insurer repairer ("Kemper" i))
        (subk-rating repairer ("A" i))
        (r-l-c repairer ("N" i))
        (gas repairer ("Y" i))
        (limit p-and-i (1000000 i))))

(defrule enter-applicant-name
(schedule single single)
=>
(assert (name applicant ("Mark Blackman" e))))

(defrule enter-broker-name
(schedule single single)
=>
(assert (name broker ("Alexander & Alexander" e))))

```