

Workers' Comp Predictive Modeling Comes of Age

By Annmarie Geddes Lipold

(And Not a Minute Too Soon)

Where there are reliable data, there's an opportunity to apply predictive modeling. In workers' compensation, early adopters are enjoying better and more accurate pricing and improved claims processes.

NOTHING MOTIVATES INNOVATION in the workers' compensation industry like crisis. Just when lower loss costs start leading to more competitive premium prices, trending undercurrents begin lurking in the industry's combined ratio.

The combined ratio of the private workers' comp industry has rarely shown profitability in the past 20 years. From 1991 through 2010, the average combined ratio is 108.3, and the 2010 calendar year combined ratio is 115.0, according to the National Council on Compensation Insurance Inc. (see table Page 36). Results from NCCI are based on data from approximately half the private insurance market's written premium.



Since the late 1990s, frequency for lost-time claims—which occur when injured workers lose more than seven days of work—has been on the decline and severity has been on the rise. Accident-year 2010 figures, however, could mean a change in trend. Frequency rose 3 percent while wage replacement costs, which have been going up consistently since 1994, saw a 3 percent decline in 2010, according to NCCI results.

Enter predictive modeling—the data analytics tool revolutionizing workers’ compensation for large pioneering carriers and self-insurers that have the necessary access to data and expertise.

Insurance predictive modeling applies statistical techniques and algorithms in considering traditional insurance and non-insurance data to develop variables that predict the likelihood of a particular situation. Think of it as generalized linear modeling up the expedient notch, verifying and creating new predictive variables thanks to greater data availability and technology. A form of data mining (the analysis of data sets to reveal new data relationships), predictive modeling techniques include logistic regression and decision tree analysis.



From clarifying underwriting and premium auditing accuracy to detecting precursors for unnecessary claim costs, this multivariate analysis is improving systems and uncovering savings in compelling ways.

Property/casualty insurers, in general, increasingly report benefits from its use in underwriting, pricing, rating, and market segmentation, according to Towers Watson's third annual predictive modeling survey released in February 2012. More than 75 percent of the survey's 60 U.S. and nine Canadian respondents are enjoying bottom-line benefits of rate accuracy, loss ratio improvement, and higher profitability.

Nearly half of the respondents—49 percent—cited a positive impact due to expanding underwriting appetite. These numbers are some 10 percent to 20 percent higher than last year's results, showing "the enduring sustainable benefits" of predictive modeling, the survey said.

Of the carriers that participated in the 2011 Towers Watson survey, 48 percent of workers' compensation insurers said they are already using predictive modeling. An additional 36 percent plan to use predictive modeling, while 16 percent do not (see table below).

Where there are enough reliable data, there's an opportunity to apply predictive modeling. Most of the largest workers' comp insurers began using predictive modeling in premium auditing, along with underwriting, pricing, and marketing, about 10 years ago, said Peter Wu, a director at Deloitte Consulting LLP.

Property/casualty carriers using predictive modeling for market segmentation are saving two to four points in their loss ratio and loss adjustment expenses (LAE) after the first year of implementation, said Towers Watson director

Workers' Compensation Combined Ratio Continues to Deteriorate

Calendar Year	Loss	LAE	Underwriting Expense	Dividends	Combined Ratio	AVG
1990	83.8	10.7	17.6	5.1	117.2	108.3
1991	87.8	11.5	18.5	4.8	122.6	108.3
1992	83.9	13.2	19.8	4.4	121.3	108.3
1993	71.7	12.4	20.4	4.7	109.2	108.3
1994	60.5	13.1	21.7	6.4	101.7	108.3
1995	55.3	12.5	23.3	6.0	97.1	108.3
1996	55.8	13.7	25.4	4.8	99.7	108.3
1997	55.5	13.8	25.9	5.4	100.6	108.3
1998	60.1	15.3	26.7	5.3	107.4	108.3
1999	65.9	15.8	28.0	5.6	115.3	108.3
2000	71.2	15.9	26.4	4.7	118.2	108.3
2001	78.0	13.8	26.1	3.7	121.6	108.3
2002	70.8	13.7	23.5	2.8	110.8	108.3
2003	70.7	15.0	22.2	1.6	109.5	108.3
2004	68.9	14.5	22.1	1.3	106.8	108.3
2005	64.5	14.4	22.3	1.3	102.5	108.3
2006	58.7	13.6	19.6	1.3	93.2	108.3
2007	60.1	14.5	24.6	1.5	100.7	108.3
2008	60.3	14.2	24.6	1.8	100.9	108.3
2009	67.6	14.9	26.2	1.6	110.3	108.3
2010	71.0	16.0	26.5	1.5	115.0	108.3
20-year average, 1991–2010	66.9	14.1			108.2	
10-year average, 2001–2010	67.1	14.5			107.1	

Source: National Council on Compensation Insurance Inc. (NCCI)

Brian Stoll, who heads up the annual survey. By improving efficiency, the process also can reduce underwriting expenses.

The private workers' comp insurance market in general could use such reductions. The loss ratio has been steadily creeping up to 71.0, according to NCCI, with the 10-year average being 67.1. At the same time, the LAE for 2010 is 16.0—the highest it has been in at least 20 years, with the average 10-year LAE being 14.5.

There are other benefits to predictive modeling besides cost savings. Zurich Financial Services, which has been using predictive modeling for workers' comp underwriting since 2008, is an example of just one carrier that has seen many benefits from applying predictive modeling.

Workers' Compensation Predictive Modeling On the Rise

Year	Currently Use	Plan to Use	No Plans to Use
2009	18%	43%	39%
2010	32%	55%	13%
2011	48%	36%	16%

Source: Towers Watson predictive modeling survey, February 2012

Quickly becoming an insurance industry best practice, predictive modeling is already doing for workers' comp what credit scoring, another form of predictive modeling, did to revolutionize pricing for private-passenger auto insurance.

The key is the consistency it offers, said Joseph Wells, head of underwriting for workers' compensation and accident and health at Zurich. "The underwriters are getting the same information and analyzing it in a more consistent way. Consistency really helps when managing an underwriting book."

It also saves underwriters research time, allowing them to give more time to customers, distributors, and less experienced underwriters. "Having that consistent way of bringing in information," added Wells, "allows for a more seamless transfer of knowledge."

Quickly becoming an insurance industry best practice, predictive modeling is already doing for workers' comp what credit scoring, another form of predictive modeling, did to revolutionize pricing for private-passenger auto insurance. But getting into predictive modeling isn't a slam dunk (see box on right).

To save even more, workers' comp carriers are turning to predictive modeling to detect fraud and improve the claims process. "Once you get started, so many other areas present themselves," said Curtis Gary Dean, an actuarial professor at Ball State University.

Looking Back With Premium Auditing

The workers' comp industry has long held that an estimated 15 percent to 20 percent of employers misreport information to lower their insurance costs. Premium auditing locates incorrect information and ensure policyholders are paying their fair share.

"Typically, the way that carriers will choose which policies to audit on-site is to first look at the premium of the policy," said Janine Johnson, director of analytics for Insurance Services Office Inc. (ISO). The organization launched a premium audit predictive modeling tool in 2010 that reveals which policyholders are most likely to need the attention of an on-site audit and which are more likely to require a large premium adjustment.

Carriers traditionally chose a dollar-amount threshold—say \$5,000 to \$10,000 or more—in annual premium and audited those risks on-site. But "premium by itself is not a sufficient segmentation strategy," she said.

Thanks to predictive modeling, carriers can detect potential misreporting using other factors. "We are trying to segment two risks with the same premium because they don't necessarily have the same characteristics, so you should treat them differently from the audit perspective," Johnson said.

BARRIERS OF ENTRY

There's no predictive modeling without data gold—sufficient amounts of clean and appropriate information necessary for revealing predictive relationships.

"If you are trying to differentiate risk in workers' compensation and workers' compensation risks are fairly diverse, you really have to have a lot of data points around the risk," said Janine Johnson, director of analytics at Insurance Services Office Inc. "If you don't, you will get erroneous predictions."

Workers' comp data are just hard to come by. "Every time you ask for something, there is a cost to that," said Curtis Gary Dean, an actuarial professor at Ball State University. Whatever data are collected aren't necessarily entered electronically, either, said Peter Wu, a director at Deloitte Consulting.

Data extraction is a challenge. The more centralized the insurer, the more centralized the data, added Wu. When carriers have different pieces of information in different parts of the organization, data can be hard to obtain, requiring numerous requests for information technology (IT) support.

Using new technology with legacy systems also can make the process more difficult because they aren't as advanced or as efficient as modern systems, he observed.

Barriers go beyond data. Investment in technology infrastructure and talent is a requirement as well, Wu said, and that's one reason many companies are behind. Getting qualified IT professionals is a barrier. "IT people know how to collect data, but they lack experience in supporting what is needed to do predictive modeling."

Underwriters can feel threatened that predictive modeling will diminish their roles, said Dean. At Zurich Financial Services, underwriters resisted predictive modeling because "changing underwriting habits can be challenging," said Joseph Wells, head of underwriting for workers' compensation and accident and health. "We had to show the underwriters what is in it for them."

Despite the barriers, predictive modeling will continue to move forward, simply because the potential return on investment is just too enticing.

Predictive modeling uses carrier and nontraditional data from outside sources to differentiate between risks. Doing so saves carriers money by putting resources into risks that actually need auditing. "You'll end up with a more accurate representation of the true exposures of the risk," she added.

It took five years to recruit development partners and develop the model, said Johnson, which ISO did in response to carriers' interest. "What we are trying to figure out is the most cost-effective method for conducting the audit."

Non-insurance data, such as wages and employment information in government databases, are part of the model to reveal discrepancies in payroll information. "We are trying to build a profile of a risk and look at how the risk has changed over time," said Johnson. The variables include location, places of operation, payroll and wages, the claims associated with the policy, and claims history.

Some policyholders go to "great expense" to avoid an adverse experience modification, she said. They might change their company in name only, not in operations, to get a clean slate for the experience modifier. Others switch between carriers to hide migration of classification codes to exchange a more

expensive classification, such as blue-collar work, with a less expensive one, such as clerical work. Roofers could be classified incorrectly as less expensive carpenters.

Many factors considered in pricing and underwriting, such as class codes and locations, are being used not only in underwriting and pricing but also at policy inception, Johnson said.

It is logical to assume that insurers are benefiting from premium auditing by applying the results to underwriting and pricing, but this isn't easy for all carriers. "It might have to do with the way they are organized," she said, because knowledge sharing is less likely to happen when auditing and underwriting are kept separate. Underwriters might take it under advisement as they have to balance many business priorities, including agents who also get involved in pricing, she explained.

The Price Is Right

Determining the right price for each risk in a workers' comp portfolio has always been challenging. Amid fluctuating markets and underwriting cycles, the long-tail line is sensitive to ever rising costs and changing legislation and regulation on a state-by-state basis.

Through the lens of predictive modeling, insurers can view traditional factors in new ways, add in non-insurance factors, and determine the degree to which factors should be considered to develop detailed market segmentation opportunities to underwrite more profitable policyholders. Predictive modeling identifies more marketing and cross-selling opportunities as well, said Dean.

The process makes use of often buried internal database information to reveal new factors for pricing. Most carriers (historically almost all carriers) fail to capture much of the non-rating information collected for underwriting, Stoll said. "Anything not needed to rate the policy was only in paper files, and the underwriter knew it and the actuaries didn't," he explained.

Predictive modeling is using data based on experienced underwriters' conventional wisdom and finding a lot of it to be true, Wu said. "We are validating the traditional business wisdom about what kind of information can be used for segmenting." For example, just as credit scoring for private-passenger auto is indicative of lower risk, workers' comp underwriters rightly assume that more efficiently operating companies should have better workers' comp programs.

The Evolution of Predictive Modeling

Workers' comp predictive modeling started after the successes in personal auto, personal home, and small commercial insurance product, said Peter Wu, a director at Deloitte Consulting. "There is a natural evolution of predictive modeling."

Insurance predictive modeling began about 20 years ago. Before predictive modeling, businesses had databases of information, but it was impossible for a human being to dig out the facts and connect the relationships, said Curtis Gary Dean, a professor of actuarial science at Ball State University.

Progressive was the first U.S. insurer to embrace predictive modeling, initially in the

form of credit scoring in the late 1980s and early 1990s, said Brian Stoll, a director at Towers Watson. The other large personal automobile insurers that followed suit immediately began gaining market share and improving results.

Then came homeowners insurance, which used real estate databases to obtain more specific home characteristics to develop more accurate pricing.

Workers' compensation and other commercial lines followed the same path as personal lines, starting with underwriting and pricing and later pursuing the claims process, Wu noted. Pioneering workers' comp carriers started applying

predictive modeling tools for underwriting and premium auditing tools at least 10 years ago. Using territorial rating for segmenting risks, another concept borrowed from personal lines, got started a few years ago in California, he added.

When it comes to predictive modeling, size still matters. It generally remains the domain of larger companies because they have access to the necessary data, experts agree.

Regional and small carriers, however, aren't doing much predictive modeling because of insufficient data, said Janine Johnson, director of analytics for Insurance Services Office Inc., which offers a predictive model for premium auditing. "They are really limited on the number of risks they have and the data points that they have to build into a model in general."

The same is true for claims predictive modeling. The top 10 largest workers' compensation carriers have enough data to do it on their own, said James J. Paugh, president of WorkersComp Analytics LLC. But smaller companies and regional companies, which make up the bulk of carriers, do not.

A Model Success Story

AFTER ROLLING OUT PREDICTIVE MODELING for medical claims management this year, Ahold USA Inc.—a supermarket chain with approximately 800 stores and 110,000 employees—expects to see annual savings in the low seven digits from a workers' compensation medical costs.

The expected savings is based on results from a pilot program in which the model was applied to 1,800 open claims last year. "What the model does so beautifully for us is that it identifies our problem claims in advance," observed James Snell, the head of predictive analytics at Mac Risk Management Inc., the division of Ahold USA that manages workers' compensation and general liability claims.

By addressing cost predictors on a per-claim basis, the model was able to project unpaid medical losses in 30-day increments, which resulted in immediate interventions to reduce claims severity. "The return on investment of a well-run predictive modeling program can be exponential," he said.

The effectiveness of predictive modeling depends on vast amounts of appropriate data. Ahold USA is in the enviable position of having a "treasure-trove of data" in its claims administration systems, said Snell, based on data collected since the company started self-insuring and self-administering in the 1980s.

The Ahold USA model uses claim characteristics, medical transaction details, and other data sources to reveal factors predictive of potential claims severity, said Rong Yi, a consultant in risk management and predictive modeling from Milliman Inc. Such indicators include multiple visits to doctors and the use of certain prescription drugs.

The model then prioritizes claims that need special



handling and medical case management, she noted. This helps injured employees receive appropriate medical care to reach maximum medical improvement and return to work sooner.

In traditional medical management, potentially problematic claims were generally difficult to identify and often judgmentally chosen using a manual process, Yi said. Predictive modeling is far more effective at detecting the claims that need immediate attention, she added. The company decided to focus on medical costs first because they were going up 8 percent a year. Wage replacement costs have been going up 5 percent annually, said Snell.

But this is just the beginning. Ahold USA plans to use this loss-mitigation approach to build predictive models to improve safety and risk management. The company is hoping eventually to learn enough to be able to offer more timely and appropriate return-to-work opportunities to its injured employees.

While implementing medical predictive modeling this year, the company intends to assess other, nonmedical aspects that could explain why injured workers are inclined to stay on workers' compensation longer, Yi said. These factors include cost shifting from other disability benefit programs, attorney involvement, and the distance an employee lives from work. Other tools, such as pain scales and questionnaires, also may be incorporated with the overall goal of maximizing employee safety, health, and wellness.

And frequency/severity-based predictive models are now a best practice in personal lines, necessitating new variables and interactions for competitive pricing, Stoll said.

According to the Towers Watson third annual predictive modeling survey, released in February 2012, almost all—97 percent—of U.S. personal lines executives view sophisticated underwriting and risk selection as essential or very important. Eighty-five percent of those said they are using predictive modeling or plan to, according to the online survey of 60 U.S. carriers and nine Canadian insurers.

For pricing and underwriting, predictive modeling is also picking up in commercial lines. Approximately 70 percent of respondents indicated they are either currently using it or planning to do so within the next two years, according to the Towers Watson survey.

The greatest commercial lines momentum is in primary commercial lines such as business owners, commercial auto, business package, and workers' compensation, for which more data enable stronger models, said Wu.

Predictive modeling, however, is taking longer to pick up in workers' compensation because it is such a unique line, Wu said, and has unique challenges and opportunities. Unlike other commercial insurance, workers' compensation has a uniform product in coverage and pricing. "There are less risk characteristics available for workers' compensation for risk segmentation than for other commercial business," he added.

Workers' comp also is lagging the most because it requires multiple data sets for which data availability for variables can be shallow. Such is the case for applying predictive modeling to the claims process, which began about five years ago, said Wu.

The health care industry, meanwhile, has been using predictive metrics for medical case management that are also applicable to workers' comp, said Rong Yi, director of the risk adjustment and predictive modeling practice at Milliman Inc. "There is a familiarity in the medical data and health care system of high cost claimant behavior that also applies in workers' compensation," she said.

In health care, the term "predictive modeling" was coined in the early 2000s to describe models containing co-morbidities, Yi said. These include diabetes, high blood pressure, depression, smoking, and other factors to detect potentially expensive claims.

Predictive modeling will grow only more attractive for insurers and other businesses. At the same time, actuaries still need to secure their role in the marketplace, experts say.

For starters, data and benchmarking organizations could be viewed as either collaborators or competitors. WorkersComp Analytics, for example, is building a claims database called the National WorkersComp Clearinghouse, which also offers metrics with results similar to predictive analytics.

Other professions, which could be collaborators or competitors, are pursuing predictive modeling as well. To stay competitive, therefore, actuaries will need to show how their expertise is necessary and more desirable. "If actuaries do not embrace data-driven analytics and provide the service, companies will secure it from other professions," said Stoll.

Factors of individual accounts can include payment history, loss control efforts, and how many and which insurance lines are being purchased—such as grouping workers' compensation with commercial auto. Just as the age of drivers is a factor in personal-auto pricing, the age of an employee is a factor in pricing workers' comp coverage.

Predictive modeling can handle more data, past and present, and can enhance or go beyond the experience modifier by differentiating what previously was "bucketed together" in the experience mod, Stoll said.

Predictive modeling can be used also to enhance segmentation in the NCCI's classification plan. The NCCI classification codes represent risk potential by occupational type. Despite having about 580 classifications that are constantly updated, the classification plan remains limited.

"Historically, pricing was done on a univariate class basis, and then adjusted for individual risks," said Stoll. "Predictive modeling ... produces much more accurate pricing at the individual risk level."

Predictive modeling is also more nimble to new information like policyholder changes to improve price risks, unlike the

experience mod, which is based on loss data from the past two to three years, he said. "Adding new employees is more predictive than the last two years with fewer employees because more employees mean more risk exposure."

Workers' comp carriers are split about their confidence regarding the appropriateness of payroll as the standard industry exposure base, according to the Towers Watson survey, with 58 percent of respondents saying they are not or are somewhat confident and the remaining 42 percent saying they are highly confident.

Changes in operations and other individual risk factors can differentiate individual risks within a class, said Stoll, and are more responsive than the experience modification factor. He offered that income levels not only are predictive of the amount of wage replacement benefits, but also the more generously employees are compensated, the more likely is high employee morale, which can positively affect claim outcomes and speed of return to work. Whether the employer provides health insurance also can affect cost shifting.

One way to apply the predictive modeling results is to build the difference between the indicated and standard premium into a schedule rating plan credit/debit, making adjustments to specific schedule factors to arrive at the target price, Stoll said. The more pragmatic approach frequently used by carriers, he said, is starting with what the predictive model says the price should be (or the price agreed on with the agent) and then comparing it with the rating plan premium. "The ratio of the two tells you how much debit or credit you want to give the risk and then charge back into the targeted premium."

Larger insurance companies, however, were initially skeptical about the ability of predictive modeling to go beyond the NCCI classification plan, and worked on other commercial lines first, Stoll said. Now the national carriers have recognized the benefit of predictive modeling in enhancing price accuracy.

For niche carriers, for example, accounting for the nuances in similar businesses can make a big bottom-line difference. "They know those niches better than competitors," he said, "and if they capture their information electronically, [they] can build their industry expertise directly into their pricing through predictive modeling."

Reducing Losses From the Beginning

Nothing makes more sense than preventing losses before they occur. Even with the best safety and risk management efforts, a work-related incident occurs and the claims process begins. Apply predictive modeling in this area and cost savings eventually can cause a domino effect all the way back to underwriting and premium auditing.

The recent uptick in frequency of lost-time workers' compensation claims might be explained partially by medical-only claims unnecessarily becoming lost-time claims. In the past two decades, despite countless system improvements, medical costs have increased cumulatively from the 1991 to 2010 accident years by an estimated 238 percent, according to NCCI. Workers'

ACTUARIES WANTED

IN THE FUTURE, all actuaries will be using predictive modeling, said Curtis Gary Dean, a professor of actuarial science at Ball State University. But for now, it's still a developing field for actuaries. "The math is pretty deep. There is a lot of math and statistics to learn to do this," he said.

More actuaries are incorporating predictive modeling into their traditional roles and are gaining good experience, said Sally Ezra, a partner of Ezra Penland Actuarial Recruitment. The demand for actuaries who offer predictive modeling continues.

"We have seen no less than six new positions open up within the past six months for people to lead new analytics teams," she said. There is also interest in using predictive modeling for new products despite data scarcity. "These are good indicators that the market is sure to continue to grow."

Actuaries who are experts at predictive modeling and very experienced in workers' compensation are hard to find, noted Ezra. "However, if a company needs someone who has predictive modeling expertise and some workers' compensation experience, the pool of actuaries could actually be quite large."

compensation medical costs meanwhile have lagged behind the medical cost index.

Conventional wisdom in the workers' comp arena says that 20 percent of claims make up 80 percent of losses. Efforts such as early claims reporting, medical case management, and return to work have long been proved essential in reducing losses.

Just as predictive modeling is providing more-consistent indicators for potential mispricing than human judgment does, it is helping to reveal potential claims problems, such as attorney involvement, unnecessary delays in maximum medical improvement and return to work, and fraud. Predictive modeling also improves system efficiency, leading to higher productivity and training opportunities for claims personnel. It eventually should improve loss reserving as well.

"In a work-related injury, the golden window is 14 days from time of injury," said Michael Shor, managing director of Best Doctors Occupational Health Institute. "If claims advisers do not engage and get as much information as possible as soon as possible, workers are less likely to benefit from efforts to improve their care," he added.

The Best Doctors Predictive Index does not use predictive modeling per se, but alerts claims examiners at the time of injury to claims needing special attention. The value of the predictive index, said Shor, is that it helps the claims examiner identify the injured worker with risk factors that are correlated with a compromised medical recovery. Index variables include questions about smoking habits, height, weight, and previous injuries. People voluntarily share this information even though they do not have to under the Health Insurance Portability and Accountability Act.

Developing predictive modeling tools that identify distinctive patterns of care or sentinel events during the life of the claim is the next logical step in this process, he added.

While Shor is positive about predictive modeling, he cautions that "over-engineering" could mean risking the golden window. Busy claims executives need information they can act on quickly. "If one tries to develop a tool with 100 percent or even 75 percent accuracy, there is a high probability that the window for corrective action will already have closed," he added.

Many of the variables being used in workers' comp claim predictive modeling are the same factors that have been benchmarks for decades. These include age, occupation, filing date, diagnosis code, specific doctors, prescriptions, and types of therapies. Wu said claims predictive modeling is more difficult than other applications because the models are severity based, rather than frequency based, as with underwriting or premium auditing. There are hundreds of possible variables from claim and nontraditional insurance sources. That also makes it tricky to determine the overall cost per claim, he added.

Traditional static variables come from "anything from the claim file," said Rong Yi, director of risk adjustment and predictive modeling practice at Milliman Inc. Injury type, job title, hours worked, and the strenuousness of the job are also good proxies for medical loss and return to work, she added.

Dynamic variables include medical costs, utilization—such as number of doctor visits—medical specialties being pursued, inpatient visits, and drug types, explained Yi. Those applying predictive modeling to medical care already are seeing positive results (see "Model Success Story" on Page 39). Since the employer role is so critical to prompt reporting and employee health, Shor believes that employers in the future will be able to get better pricing based on work forces with healthier lifestyle risk factor profiles. "I think what we have done moves it all forward in a dramatic way," he said.

Quantifying Traditional Wisdom

The future of workers' comp predictive modeling is not just exciting for actuaries and insurers. It also gives hope to those at the heart of the system: employers and injured workers.

By quantifying traditional wisdom—that employers need to encourage immediate claim filing to facilitate return to work at medical feasibility—predictive modeling will play a key role in the system's elusive goal: stabilizing wayward cost cycles and crises. □

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