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Chapter

Different Market Methods for Transferring Financial Risks in Construction

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Abstract

A goal of risk management in construction is to minimize risk exposure and the total cost of risk for a project. To this end, there are a variety of market mechanisms available for transferring risk and/or the financial consequences of a risk realization (e.g., transfer the financial consequences of a risk to an insurance company or use contractual non-insurance risk transfers such as hold harmless agreements to allocate financial responsibility to another party). Unique characteristics of construction risks are examined along with a discussion of which of these risks are insurable and which are not. The advisable risk handling mechanism to use (insurance, non-insurance transfer, retention or self-insurance, or some other technique) is provided Both the construction firm and its client must anticipate potential undesirable event occurrence with initial project planning, and build both downside risk protection and resilience into its risk management strategy. Future emerging technological advances and their impact on construction risks are discussed.

Keywords: insurance risk transfer, liability, contractual risk transfer, construction financial risk, future evolving construction risks

1. Introduction

The risk management market provides many opportunities for mitigating financial risks in construction. The risk management process consists of identifying risks, measuring risks and then deciding how to handle the risks. Once identified, risks can be avoided, retained or transferred (The A-R-T of Risk Management). There are ways of doing this, such as retaining, mitigating the risk through actions that reduce the frequency and/or severity of the risk consequence, or contractually transferring the risk to another party, either through insurance or contractual risk transfer agreements.

This chapter focuses primarily on transferring the economic (financial) consequences of losses that result from risk realization in the construction industry. We particularly explore available optimal financial risk transfer techniques, including various insurance products, and methods for transferring the financial consequences of risk realization through contractual agreements. We conclude with a section on indemnifying the financial considerations associated with new and evolving risks such as changing technology.

Construction contracts are often written with incentive clauses based on the contracted for completion date. When construction is finished ahead of schedule the contractor is rewarded a pre-specified amount per day. If the project finishes after the deadline, a pre-specified penalty is assessed for each day late. Thus, risk realization in the construction process can have twofold financial consequences: direct and indirect costs of liability and damages. We cover direct losses to property, liability to contractors, business interruption coverage (e.g., delay in start-up or completion insurance and contingent business interruption in supply chain management), worker's compensation liability, and other important insurance mechanisms pertinent to construction risk management.

2. Transference or retention of the financial consequence of risks in the construction industry

2.1 Mechanisms for risk transfer in construction

Construction firms are subject to a variety of risks with sometimes almost limitless financial consequences. Left unhandled or uncontrolled, the financial consequences of an adverse risk realization can be bankruptcy. There are several different mechanism available to the contractor (and subcontractor) which can transfer these financial consequences to another party. Contractually transferring the financial risk consequences to an insurance company by buying insurance policies designed for the specific risks affords a common method of risk transfer. A non-insurance risk transfer mechanism inserts risk transfer language into the contract of work between the contractor and other entities on the worksite so they bear the risk instead of the contractor. Each of these is discussed in more detail subsequently, along with self-insurance alternatives.

2.2 Self-insurance as an alternative risk handling technique

Not all risks can be transferred, either through insurance or through contract. According to [1], the top five uninsurable risks faced by the construction company (and needing self-insurance and risk mitigation strategies to address) are reputational risk, regulatory risk, trade-secret-intellectual property risk, political risk, and pandemic risk. With such risks the contractor must choose to either avoid the risk altogether (e.g., not bid on a contract that is deemed too risky or for which the experienced and skilled subcontractors are not available) or the contractor must retain the risk and any financial consequences internally. Alternatively, a large construction company may find risk transfer an ineffective way of hedging a particular risk, and hence choose to assume that risk; otherwise known as the self-insurance option. It is called self-insurance because it is risk financing, like insurance, but with the financial consequences paid by the company itself instead of the insurer paying. In spite of what the name may imply, self-insurance involves no transfer of risk.

All companies engage in self-insurance. Since insurance products generally have a deductible or co-pay, and a limit of liability, the contractor always faces the assumption of some of the risk (that below the deductible and above the policy limits, for example), so they are "self-insuring" these losses. Additionally, there are some risks, such as the risk of incurring criminal fines and penalties, that are not insurable, nor is there a contractual risk transfer option available. For these risks, the contractor must retain the financial consequences internally.

Self-insurance can be planned or unplanned retention. Unplanned retention occurs when the company failed to recognize a particular risk, and therefore has not prepared for addressing its financial consequences, and must pay losses internally. This can have significant consequences if losses are severe enough.

Two formal techniques for planned self-insurance are prefunding a risk account to pay for claims internally as they arise, and forming an insurance company as a subsidiary of the construction company and then buying insurance from this insurer. This insurance subsidiary is a "captive insurer". Not all companies are large enough to take advantage of these techniques, however.

Insurance companies can accept risk from others because the statistical law of large numbers and central limit theorem allow them better estimate expected losses for a risk pool, and with greater precision, than could an individual insured. By pooling a large number of similar exposures, the insurer both diversifies the assumed risk, and increases precision in estimating average losses, the basis of a premium. Administrative expenses and profit loading are added to the expected loss to arrive at a final premium to charge the insured (see [2, 3]). By knowing the expected loss for an individual insured and how much variability there is across different insureds, the insurer determines how much money they need to keep in a reserve account to pay claims with high probability.

If a non-insurance company has a sufficient number of exposure units, they can avail themselves of this same process as the insurer described above and determine the amount needed in a bank account to have sufficient funds to pay claims. The benefit of this formal self-insurance arrangement is that there is no administrative fee or profit loading charge, thus making the pre-funded bank account approach to self-insurance more economical for the company. The process may also allow for wider coverage than available on the open insurance market. Usually a company will hire a third-party administrator to assist with claims adjusting and claim payments.

The second self-insurance alternative available is to form a subsidiary that is an insurance company, and then have that insurance company write the insurance for the parent company. This subsidiary is a captive insurance company. A pure captive is an insurance company subsidiary that only insures the risks of the parent company. A pure captive is a very formal type of self-insurance since the financial consequences of the risk have not been shifted outside the original parent company. Other types of captive insurance companies can write the business of the parent as well as outside unrelated businesses. There are tax implications concerning the deductibility of the premiums paid to a captive insurer (depending on how spread the risk is between insureds), and expert tax advice is needed here. The benefit, of course, is that the profit from the insurance business is retained internally while still satisfying insurance requirements (such as the mandate to insure workers' compensation risk).

As with self-insurance generally, only very large companies can feasibly handle risk by forming a captive insurer (due to capitalization requirements). Risks in the construction industry often sent to captive insurers include workers' compensation, commercial automobile, builders risk and general liability. The captive then writes insurance policies covering these risks of the parent company.

Industry groups can also jointly form group captive insurers, and there are several in the construction industry. The benefit of joining a group captive is the additional diversification, the deductibility of premiums, and the fact that by joining an existing industry group captive, there is specialized industry expertise concerning the types of risk faced. The captive also has access to the reinsurance market (which an individual construction company does not have) and can often get insurance coverage at a lower rate than from a regular insurance company.

3. Insurance contracts facilitating risk transfer

The primary technique for transferring the financial impact of construction risks to others is through the purchase of various types of insurance. This section considers which types of construction risks are amenable to insurance and the types that are not. We then examine various important construction risks and insurance solutions to the transfer of their financial consequences.

3.1 What constitutes insurable construction risk?

Since only some risks are amenable to an insurance transfer solution, we first consider the unique characteristics of construction risk, and then describe the ideal characteristics for a construction risk to be insurable.

3.1.1 Unique aspects of construction risk

While construction is a form of manufacturing business (taking raw input materials, capital and labor to create a finished product), the differences between traditional manufacturing risk management and construction risk management are many. Risk management of construction projects is especially challenging and complex due to the unique characteristic that each project brings with it. First, the location of the construction enterprise is not fixed, as there may be several construction projects going on simultaneously resulting in many employees in various worksites and transiting between different workplaces.

The safety and risk management of each worksite must be evaluated separately (and continuously) as environmental hazards or exposures can differ from site to site (e.g., one site may have flood risk, another fire risk, another vandalism and theft risk, etc.). In international construction firms, liability risk can differ according to country and legal system. The same risk management or insurance plan will not be applicable to all projects due to location differences, beginning state and ending state site differences, differing neighboring buildings and their vulnerability, differing owners, deliverables, and contracting agreements between the owner and contractor.

Each project is also unique in terms of people working at the site. Numerous subcontractors are generally involved on a construction project, all working simultaneously at the same worksite, each subcontractor with their own contract workers, and with varying skill levels and risk culture. Coordination problems regarding safety and attitude toward risk-taking can occur. Additionally, many subcontractors are small and potentially undercapitalized, so that even if they sign a hold harmless agreement, they may not be able to live up to the assumed financial responsibility agreement (leaving no effective way to enforce it).

Depending on the terms of the contract between owner and contractor, construction projects can become adversarial due to financial pressures and uncertainties. Adversarial relationships may produce negative consequences for cooperation, safety, and the management of other risks. Fixed price contracts can exacerbate owner-contractor conflicts resulting in potential increased losses due to decreased attention to safety and risk management by the contractor (because of financial constrictions). Cost plus pricing can reduce the potential for safety and risk management related losses but increases costs. Many of these issues are also unique to construction contracts [4].

Additionally, construction projects are very labor intensive and often are performed under harsh conditions, adding to the riskiness of contracting. Management of risk becomes more important for construction since clients, specification, and workers differ from project to project.

3.1.2 Ideal conditions for insurability of a risk

Risks can be dichotomized into pure risks and speculative risks. A pure risk has a chance of loss or no loss, but no chance of a gain (e.g., a motor vehicle or a construction workplace accident). There is no gain in this situation. Speculative risks, such as investment in the stock market or contracting to build a project in the hopes high profitability, either can result in losses or gains. Pure risks are potentially amenable insurable but speculative risk are not.

However, not even all pure risks are insurable. The ideal characteristics of an insurable risk, as delineated by most risk management texts (e.g., [2]) are:

1. There should be a number of independent similar exposure units as viewed from the perspective of the insurer. This allows access to the law of large numbers from statistics to set premiums.

2. The losses that occur should be accidental or by chance.

3. A catastrophic loss should not be possible. Quite simply, a catastrophic loss, if transferred to the insurance company, could bankrupt the insurer, a likelihood not desired by the insurer. Also, catastrophes tend to violate condition 1 since adjacent properties are more likely to simultaneously experience losses making losses not independent.

4. Losses should be definite in time and measurable in loss size. Since insurance contracts are for a specified period, the insurer must be able to tell if the loss occurred during the period, and they must be able to measure the loss for claims payment and to determine premiums.

5. The probability distribution of losses should be determinable. Premium setting is essentially a statistical exercise so one must know the possible loss sizes and the likelihood of losses of various sizes to set premiums.

6. The cost of coverage should be economically feasible to provide and to buy. If the premium is unaffordable to the insured, or if the cost of underwriting (selecting and pricing) the risk is too high for the insurer, then an insurance contract will not be created.

Many risks found in construction are insurable (and discussed below). These include: workers' compensation for workplace injuries; builders risk insurance for damages during construction; general liability insurance; professional liability insurance; delay in completion insurance; insurance covering certain operational risks (such as defective construction or faulty workmanship claims); supply chain risk losses due to interruptions or damages at a supplier upon whom the contractor is depends for their own performance, and other risks like subcontractor default or financial failure.

3.2 Construction risks amenable to insurance risk transfer and relevant available insurance policies

Several standardized insurance risk transfer policies are available for use in alleviating the financial consequences of risk realization at construction sites. These policies cover different aspects of construction risk and generally satisfy the ideal characteristic of an insurable risk discussed previously.

3.2.1 Builders risk insurance

Builders risk insurance (aka "course of construction insurance") is a policy to protect the risks to property associated with a project under construction. It is insurance often written on an "all risk" basis, meaning it covers all risks except those specifically excluded by contract language. Such a policy does include a wide range of pertinent construction risk exposures such as materials, equipment, and partially completed work (completed operations however is covered under the Commercial General Liability policy). Losses can be the result of theft, fire, explosions, wind damage (except in some coastal areas), hail, glass breakage, etc. Usually excluded are ordinary wear and tear, corrosion and rust, mechanical breakdowns, employee theft, acts of war and terrorism, and damage due to faulty workmanship, materials, or planning. Builders risk insurance is essential, and covers exposures not covered under standard property risk policies since there is much higher risk of loss during the construction phase.

There is no "standard" builders risk insurance policy in the marketplace (all projects differ), so the builders risk contract should be read carefully. If the policy selected is written on an "all risk" basis it may be that certain construction defects or even faulty workmanship are covered, however this will generally depend on the contract language. Some policies have a faulty workmanship exclusion, for example. Builders risk insurance is typically project-by-project with coverage starting once the building materials are delivered to the worksite and stopping when work is complete and the finished project delivered. If a contractor or owner is going to insure several projects at the same time, they can obtain coverage on a blanket basis, which may reduce costs. Defects discovered after job completion will not necessarily be covered by builders risk insurance, and another type of insurance is needed to cover these [4].

3.2.2 Workers' compensation insurance

A very large percentage of a contractor's expenses are attributable to workers' compensation (WC) costs. Among all occupations in the USA in 2017, construction labor workers ranked as the ninth highest in terms of the number of workplace injuries and illnesses [5], and contributed 2.6% of all workplace injuries and illnesses in the USA. A 2010 report from the Bureau of Labor Statistics (BLS), said the average employer cost for workers' compensation insurance nationally was 1.6% of spending but for the construction industry this rate was 2.75 times higher (at 4.4%) [6]. A study by the National Institute of Occupational Safety and Health (NIOSH) has documented that construction industry workers experience higher rate of fatalities and injuries and higher amounts of lost work, increased WC claims and disability than the other industries. Additionally, smaller construction firms are worse, with firms having less than 10 employees being responsible for half the fatal injuries while only comprising a fourth of the construction industry [7]

All USA states (and most countries in Europe) have workers' compensation laws, and purchase of workers' compensation insurance to fulfill the statutory requirements of the WC laws is required in all USA states except Texas.

The objective of the WC system is to provide a mechanism to compensate workers' workplace injuries. The WC laws in various jurisdictions require employers to pay workers a statutory amount for work-related injuries and illnesses without regard to who caused the injury or illness, that is, the employer has strict liability (no negligence is needed for compensation). Strict liability adds additional financial incentive for employers to improve work conditions. As a counterbalancing to the WC laws, the workers' compensation system provides WC settlement as the exclusive remedy for the worker to recover damages. This means they cannot use the legal system as a remedy for costs or damages that reduces costs to the employer [2].

WC insurance provides four main coverages: medical costs for the injured worker, a reimbursement of a portion of the injured worker's wages, rehabilitation services for the worker, and death benefits of the worker who died in a workplace accident. All WC systems provide these four benefits, however the level of the each of these benefits can vary substantially state to state.

Of course, the likelihood and severity of a job injury differs significantly by employment duties, i.e., an office worker will have a much lower workers' compensation insurance rate than a carpenter or a roofer working for the same contractor. Insurers set premiums for the construction firm in accordance with the number of workers they have in each job classification [2, 4].

Several types of WC rating plans are available for larger sized insured. These include having experience rating where an "experience modifier" is created for the firm according to how their historic loss experience has been relative to the average insured's loss history. For example, if the loss history of a particular contractor is only 85% of the average contractor's loss history, then the modifier of 0.85 is applied and the premiums paid by this contractor will only be 0.85% of the manual (average) WC rate. The multiplier can also be above 1.0 if the contractor has worse than average loss experience. Experience rating provides another incentive for workplace safety to save on mandated premiums [4].

A common rating plan used by large contractors is the "retrospective rating" plan. This is similar to experience rating except the actual rate paid is determined at the end of the policy period based on actual experienced losses during the year. This retrospective adjustment of premiums at the end of the policy period can save money for doing a good job of controlling losses during the policy period. Of course, the contractor who does not control losses may be forced retroactively to pay additional premiums. Again, this provides incentives for safety and loss control. Another distinction between experience rating and retrospective rating is that in retrospective rating the contractor does not know what their premiums will be until the end of the premium period.

In construction, it is common for subcontractors on a jobsite to have their own WC insurance. A general contractor should make sure all subcontractors have WC insurance since this may affect some of the contractor's own defenses against claims by injured workers. For example, in many jurisdictions, "statutory employer immunity" that protects the owner or general contractor against claims by subcontractor's employees only applies if the general contractor has a written requirement that all subcontractors carry sufficient WC insurance [8]. For a detailed description of WC coverage, details on the history, current issues and controversies see [2].

3.2.3 Commercial general liability (CGL) insurance

A major category of insurance coverage for owners and contractors is Commercial General Liability (CGL) insurance. This generic product covers all liability exposures except those that are specifically excluded. Typical exclusions include automobile liability, workers' compensation liability, professional liability, certain injuries incurred during the construction itself, certain liabilities for faulty workmanship, and liability for completed products. Some of these can be added back by attaching an endorsement to the CGL, and most others are excluded because they are handled best by a separate policy (e.g., a commercial automobile policy, a workers' compensation policy, etc.).

The CGL policy has three major coverages: Coverage A—Bodily Injury and Property Damage Liability, Coverage B—Personal and Advertising Injury Liability, and Coverage C—Medical Payments. We examine these in turn.

In the bodily injury and property damage section, the CGL covers bodily injury or property damage caused by "an occurrence" for which the insured is legally responsible. For coverage to apply, the damage must arise from the insured's products, or completed works, or operations performed on or off site. If a lawsuit occurs, the CGL policy provides a lawyer to defend the claim.

The personal and advertising injury liability coverage (Coverage B) differs from the Coverage A in that the Coverage A is very broad whereas Coverage B only covers claims for specific offenses. If a claim does not arise from one of the listed causes, it is not covered. Another difference is that Coverage A covers damage from an occurrence resulting from negligence of the insured, which is unintentional. Coverage B, on the other hand, covers specific intentional or deliberate acts that result in harm and which arose out of business operation.

The medical payments Coverage C will pay (without their needing to be a lawsuit) for a third party's medical expenses associated with an injury from an accident occurring in the course of business activities of the insured without regard to who was at fault, and without a lawsuit. This differs from Coverage A and B where the insured needed to be responsible for the injury to be covered.

3.2.4 Professional liability insurance

Professional liability (also called errors and omissions) insurance protects a professional service provider from being held fiscally responsible in a professional negligence lawsuit. The coverage pays for defending against the claim that the insured failed to perform their professional service, or produced a professional product that did not meet normal professional standards, and that this failure to give adequate professional service resulted in a loss to the client. The coverage focuses on financial loss caused by alleged errors in professional judgment, or omissions of required and usual professional responsibilities, failure in professional oversights, or professional negligence in the service or product sold by the insured. Professional liability claims are not generally covered by a CGL insurance policy. The professional liability insurance policy is usually written on a "claims-made" basis, meaning that claims are only covered if they are made during the policy period. Common exclusions in professional liability policies are intentional or dishonest acts, and bodily injury and physical damage claims (as these are covered by CGL policies).

On the construction site, engineers, architects, electricians, plumbers, and other professionally licensed workers are held to have up-to-date professional knowledge and ability and work to professional standards. They can be held liable if their work is not up to standard and causes losses. For example, there are now professional liability lawsuits against the structural engineers, architects, and developer in the sinking and tilting 58 story Millennium Tower completed in 2009 in San Francisco, California. Because of this tilting and sinking, the tower has a minimum $200 million in repair costs, plus lost property value [9, 10].

A relatively recent product in the professional liability insurance marketplace (Contractors Professional Liability Insurance developed in the 1990s) protects contractors who engage in design-build work. Like builders risk insurance, it can be project-specific if the contractor is only doing design-build on some projects. Prior to the availability of contractors' professional liability insurance, the coverage alternative available was to add an endorsement to a design professional liability policy, and a few insurers only offered this. Coverage extended by this endorsement was typically limited to the contractor's vicarious liability for design errors and omissions inherited from a third party (e.g., an architect or structural engineer hired by the contractor), and not that of the contractor [11].

3.2.5 Commercial umbrella insurance contracts and excess liability policies

An individual primary insurance contract covers pre-specified financial consequence of a risk realization (stated in the contract) from above the specified deductible up to policy limits. If the experienced loss goes above that policy limit the contractor (or owner) is still liable for the risk consequences. Until this point in the chapter, we discussed individual primary insurance contracts like WC insurance, builders risk insurance, CGL insurance, and other primary insurance contracts (and clauses). These are viewed separately according to the risks they cover. To cover the risk of loss above the policy limits of a given liability policy, the contractor has the option of buying an additional (supplemental) policy that takes over the indemnification obligation above the maximum limits set in the underlying policy. This second policy protects the insured from potentially catastrophic losses associated with a very large liability claim. Such secondary policies are "excess insurance policies" (as they pay losses in excess to what the primary insurance pays). When the excess policy provides the same coverage details (insured events) as the primary insurance policy, the policy is a "following form excess insurance" policy. A detailed examination and discussion of the excess and surplus insurance market is given in [12].

Another possibility to raise coverage limits for an insured exposed to multiple risks is to purchase an umbrella insurance policy. The umbrella policy, at the same time and within the same contract, provides supplemental coverage in excess of the policy limits of several distinct underlying insurance policies. Thus, the umbrella policy could cover losses in excess of the policy limits of any of builders risk insurance, workers' compensation insurance or general liability policy. Instead of buying three" following form excess" policies, a single umbrella policy provides the additional limit extension to a uniform project limit that is over all the risks and is the same excess limit for all the risks covered. The umbrella policy provisions usually set a minimum on the maximum payment limit requirement for each underlying policy it spreads above since the umbrella policy is secondary, and so the umbrella insurer wants higher limits on the underlying primary policies insurance policies so they have less to pay [2].

The market for excess and umbrella policies exists to provide the contractor with an option to raise the upper coverage amounts for all underlying policy exposures to have a consistent uniform higher limit on all. Even umbrella policies have upper limits, however, so at some point the insured must be willing to self-insure large risk consequences. The maximum coverage level the contractor sets for their umbrella can be a complex choice made in collaboration with their insurance broker. If the contractor requires subcontractors to hold high limit umbrella policies, then the contractor may hold lower limits on its own policy.

3.2.6 Delay in completion or delay in start-up insurance

As noted previously, construction contracts often have incentive clauses that provide a pay bonus (per day) for finishing the project ahead of the agreed upon completion date, and impose a penalty per day for projects completed behind schedule. Unexpected delays create unexpected losses for owners, developers, construction companies, or others with a stake in the timely project completion.

There is insurance coverage available to help transfer some of this risk to an insurer for indemnification. Called delay in completion (DIC) coverage (also known as delayed completion coverage, and sometimes delayed start-up, or delayed opening coverage, or soft costs coverage (like extra accrued real estate taxes, etc.), or advance loss of profits coverage, or loss of anticipated revenue coverage), it is similar to business interruption insurance. It is written typically as part of a builders risk

policy (or a marine cargo policy wherein it covers delays due to late arrival of critical shipped materials or components to the worksite). DIC policies can vary significantly from policy to policy, but DIC policy forms require the delay in completion to be caused by direct physical damage or direct physical loss to insured property. The period of indemnity is limited to an agreed upon maximum length beginning when the business that contracted for the construction would have started operation, if not for the loss. The length of the indemnity period is the time needed to remedy the delay loss. Importantly, the coverage trigger date is only applicable for start of the delay claim if the contractor can show that they would have completed on time if not for the direct physical damage or loss to insured property. To show this, the contractor may have to hire an expert, and this may be covered by the insurance.

It is important to read the policy language because not all delays are covered by all policies. Causes of delay which may not be covered depending on the contract are delays caused by having a need to redesign or rectify discovered faults or defects, damages for breach of contract, site shutdowns due to inadequate funding, or losses due to fines and penalties causing delay [13].

3.2.7 Subcontractor default insurance

General contractors compete for dependable subcontractors, particularly when construction is expanding. However, when subcontractors fail, general contractors face a host of challenges, including project delays, costs associated with work stoppage, complexities arising from trying to replace the subcontractor and potential reputation damage. Such risks tend to increase in booming construction markets, as subcontractors may take on more work than they can handle, which can exacerbate cash flow struggles. Subcontractor default insurance can help the contractor hedge this risk. In addition to contractually requiring the subcontractor have their own insurance with the contractor listed as an additional insured, and having the subcontractor agree to a hold harmless agreement written into the master contract with the subcontractors, a subcontractor default policy can be very useful.

Subcontractor default insurance, introduced by Zurich Insurance about 25 years ago, provides a way for contractors to transfer the financial consequences of subcontractor's default or non-completion of work. Until recently, few insurers have offered the product, but the market is expected to expand, and become more available to smaller contractors [14].

Retention levels on the policy (the deductible) vary from $500,000 to several million dollars, although retention levels have been going down. The premium rate charged to transfer risk to the insurer vary according to the contractor seeking coverage and depend strongly on the individual contractor's prequalification procedures for their subcontractors, on the loss history of the contractor, and on the specific loss control mechanisms implemented. The rate for subcontractor default insurance is usually fixed for 2 or 3 years [14].

The leading historical reason for subcontractor default is financial, followed by quality. There are more defaults now because of labor shortages than anything other reason. With an insured's increase in claims, insurers may make policy changes to keep the insurance viable, such as excluding coverage for problematic trades (e.g., framing) ([14], quoting Rose Hoyle).

3.2.8 Operational risks: Insurance against defective construction or faulty workmanship claims

While a large number of liability risks are covered by the CGL policy, these relate mostly to third party fortuitous or accidental bodily injury and property damage.

Most insurers have traditionally considered claims about faulty construction or workmanship as a "business risk" for the contractor. Thus, monitoring workmanship was to be taken on as a normal part of monitoring the quality of work performed while doing business, and this was viewed as being under the control of the contractor. Insurers therefore have generally excluded such claim responsibility from coverage by appending a standard "faulty workmanship" exclusion clause to the CGL policy.

If the contractor's completed work or product is faulty, or if the work is not what was contractually specified, the contractor's unendorsed CGL policy will generally not cover the costs to remediate it (but see the builders risk section for in-progress claims). A California court elucidated this as follows, "Generally liability policies… are not designed to provide contractors…with coverage against claims their work is inferior or defective.… Rather liability coverage comes into play when the contractor's (insured) defective materials or work cause injury to property other than the insured's own work or products." See Clarendon America Ins. Co. v. General Sec. Indem. Co. of Arizona, 193 Cal. App. 4th 1311, 1325 (2011), sited in [15].

The contractor can, however now buy an endorsement covering faulty workmanship from some insurers [16, 17]. These endorsements provide funds for claims due to faulty workmanship, materials, or products, even if discovered after the project termination. It is worth noting, however, that the coverage is only applicable for policies in force, so terminating (canceling) the policy when the project is done but before the expiration of the statute of limitations for clams has expired may leave a risk exposure for late filed claims. The contractor should check coverage with a broker since coverage interpretation of the CGL language is on a state-by-state basis, and many insurers have now created new coverage endorsements redefining the scope of coverage.

3.2.9 Supply chain risks for contractors and contingent business interruption (CBI) insurance

Supply chain risk is created by disruption in the sequencing of permitting, subcontractors' arrival for work, and the arrival of materials at the worksite when needed. Additionally, particular owner specified items can also be problematic to source, and owner-imposed requirements and impacts need to be documented to help manage this risk. Demand for globally sourced products such as marble from Italy, Saltillo tile from Mexico and machinery from Germany have increased. At the same time, the supply chain inventory for these products has become "leaner" and the use of "just in time" inventory control has grown in response to a competitive desire to increase efficiency and save inventory or holding costs. When the supply chain is properly functioning, such processes can result in cost savings. On the other hand, losses can occur if suppliers have disruption, such as an earthquake in Mexico or Iceland's Eyjafjallajökull volcano that shut down air traffic over much of northern Europe in 2010 (disrupting supply chains worldwide). These natural catastrophes can cause delays in the arrival of construction material and construction progression can suffer. Since the damage did not occur to the construction project's own physical site, losses associate with these supply chain disruptions will generally not be covered by the usual builders risk, general liability, or the contractor's other policies.

There is an insurance policy that covers the risk of a supplier having damages that affect the contractor's ability to perform on their own construction project. This product is Contingent Business Interruption (CBI) Insurance. It covers losses to the contractor due to a disruption or delay in receiving products, components, or services from a supplier because of an incident at a supplier's property. Non-physical damage events affecting the supplier could include strikes, pandemics; civil or military action; and regulatory actions against the supplier. The CBI policy can be written to cover either incidents at the location of a particular single named

supplier or it could cover all suppliers depending on the terms of the contract. Coverage under these policies is triggered by interruption to contractor due to supply chain or logistical failure [18].

It should be noted that Contingent Business Interruption Insurance is different from regular Business Interruption (BI) Insurance. CBI covers the risk of damage (loss) to the contractor due to an incident at a supplier's location. On the other hand, regular BI Insurance addresses the risk of losses arising at the contractor's worksite that cause losses and interruptions to the contractor.

4. Non-insurance risk transfer: contractual transfer embedded within other contracts

The contract between the owner and the general contractor (or the contractor and the subcontractors) specifies the terms and conditions, details of construction, material, deadlines for completion and many other project specific details. The contract also identifies and allocates risk. Some risks that might be borne by one party can be transferred by mutual agreement to another party in the contract. Here we consider several risk transfer mechanisms available to the two parties signing the master construction contract that can be embedded within the master contract.

4.1 Risk transfer as part of subcontractor agreements

The decision as to who bears the risk in a construction project should generally worked out contractually. Risk created by a subcontractor or its employees can still come back to affect the contractor through the legal doctrine of *respondeat superior* and the existence of vicarious liability of the contractor (the liability of an employer or supervisor for liability generated by their employees). Often contracts are written between the contractor and subcontractor in such a manner as to make sure the risks created by a subcontract do not adversely affect the contractor. There are several important techniques to transferring risks contractually, and we discuss these below.

4.1.1 The contractor as an additional on subcontractor's insurance

An insurance contract is a legal contract between the insured and the insurer that agrees to pay specific amounts for claims filed within the policy period that satisfy the terms of the policy. A liability insurance policy such as the CGL policy, for example, will pay any liability claim amount (damages) that meets the conditions of the contract plus litigation costs up to the specified policy limits. Since the policy is a contract between the insurer and the insured, only the insured can file a claim against the policy. Thus, for example, if a contractor hires a subcontractor who causes physical damage, bodily injury or liability expense related to the construction project, only the subcontractor can file a claim on their insurance policy. Since filing of claims can make subsequent experience rated insurance purchases more expensive, the subcontractor may be reluctant to file a claim. A way around this is for the contractor to have written into their general construction contract with the subcontractor that they (the contractor) be listed as an additional insured on the subcontractor's insurance policy. This gives them equal status to talk with the subcontractor's insurer, and the contractor now has the ability to file claims against the subcontractor's policy.

If there is a claim the contractor has against the subcontractor that would trigger coverage by the subcontractor's insurance policy, the contractors can give permission for their own insurer to deal directly with the subcontractor's insurer, as they are a party to both contracts. By using the additional insured route to the subcontractor's

insurance policy, the contractor can have the requisite damages and defense costs paid without drawing upon the policy limits of any other policy they might have. This also saves the contractor money on experience rated insurance policies, as the adverse claim experience does not go on the contractor's claim record.

It is also desirable that the contractor have written into their contract with the subcontractor that they be listed as having primary (as opposed to excess) additional insured status on the subcontractor's policy. Primary insured status means that the subcontractor's policy becomes the primary policy (pays first) instead of the contractor's own policy when a claim is filed, and it will pay up to the policy limits of the subcontractor before tapping any of the contractor's own insurance policies. The contractor's policies are then secondary insurance and pay whatever is left on the claim above the primary insurance policy's limits. Transferring claim costs to the subcontractor's policy helps control the contractor costs and allows them to retain their own policy coverage unused. If the contractor were listed as an additional insured on an excess basis, then the contractor's own policy becomes primary (and pays first up to policy limits) and the subcontractor's policy becomes excess and only pays the costs in excess of the payment under the contractor's policy.

Many contractors write into their original agreement that they be continued as an additional insured for as long as possible since claims may arise long after the subcontractor leaves the worksite. The contractor can mandate they obtain a Certificate of Insurance from the subcontractor that shows coverages as well as listing the contractor as an additional insured.

Several different forms and endorsements exist for listing the contractor as an additional insured on the subcontractor's policy. The most favorable risk transfer (for the contractor) is to have additional insured status with an endorsement that includes both work in progress and completed work (an ongoing operations endorsement and a completed operations endorsement). These endorsements can be recommended by the contractor' insurance broker [19].

4.1.2 Owner and contractor controlled insurance programs and wrap-up insurance

Every construction project contains multiple subprojects and multiple sources of potential risk of losses. The larger the project, the more subcontractors there are on the project, the more varied, complex, and potentially overlapping are the risk and potential losses. In smaller or traditional construction projects, each subcontractor takes care of their own risks through their own insurance, and the contractor requires a hold harmless agreement and to be listed as an additional insured. With a large-scale project, (e.g., $50–100 million) there are savings by having all contractors or subs covered under a single policy. Because of the potential interactions of different subcontractors, there can be duplicative coverage for some risks, and disagreement (and litigation) among subcontractors (and their insurers) as to fault. Subcontractors have their own insurer giving the potential for litigation among insureds as to who pays first. There can also be lack of uniformity of policy limits, conditions, terms and conditions specified by each insurer. Finally, the owner should be listed as an additional insured on all relevant policies (e.g., contractor and sub-contractors), which may create costly duplicative coverage of owner's risks.

A solution to this situation is for one party to obtain insurance policies that covers multiple other parties working on the construction project. One insurance policy covers the entire project instead of each of the multitude of subcontractors each with their own insurance policy covering just their piece. This arrangement to have one insurance policy cover the entire project is a wrap-up insurance program, as all subcontractors' risks are "wrapped up" into a single policy. The goal of a wrap-up program is to reduce total insurance costs for the project while affecting consistent

coverage. If the owner is the lead party who arranges for the single insurance policy that all contractors and subcontractors subscribe to, the arrangement is an Owner Controlled Insurance Program (OCIP). If the general contractor is the lead party with subcontractors as subscribers, the arrangement is a Contractor Controlled Insurance Program (CCIP). A number of large contractors are now considering wrap-up insurance programs, and CCIPs are much more common today than in the past [8].

There are several advantages of a wrap-up insurance program (either OCIP or CCIP). First, it provides uniformity of coverage with a single insurer. This eliminates duplicative coverage and differences in conditions and limits. It eliminates costly legal bickering between the subcontractors' insurers over who has responsibility of a claim, which can eat into the policy limits of the coverage. It allows for more advantageous "economies of scale" in negotiating with the insurer over price. All these factors can reduce total premiums. Subcontractors pay their "share" of the premium and do not get project insurance on their own.

Centralized loss control and safety policies can be affected by using the wrap-up plan, making for uniform loss control incentives. Importantly, the wrap-up program can complicate the bidding process as the use or non-use of the wrap-up arrangement can greatly affect each subcontractors' insurance related costs. For effective bidding, subcontractors must know their insurance costs, thus, the creation and details of the wrap-up arrangement must be explicitly determined before bidding and project commencement.

The goal of the OCIP or CCIP is to save insurance costs so it usually only includes coverages for which there would be cost savings by having the individual policies wrapped up into a single policy. Typically, these include workers' compensation, CGL, builders' risk, and sometimes umbrella insurance coverage. Other coverages like commercial automobile or professional liability do not offer the potential cost savings and are not generally included in the wrap-up program but rather continue coverage by individual subcontractors [4].

4.2 Hold harmless and indemnification agreements

A hold harmless agreement is a contractual agreement between two parties that specifies how the risk of liability arising during construction will be distributed. The contracting parties to the hold harmless contract agree among themselves, before any loss occurs, on how to split the costs of a risk realization. Usually hold harmless agreements are embedded clauses within the general construction contract and they shift the risk from one party (who originally holds the risk) to another party. From an economic efficiency perspective, this transfer might be done in order to place the financial responsibility with the party that has best control over the risk, hence creating an enhanced financial incentive to control risk by the party that best has the ability to control the risk. Alternatively, the transfer of risk might place the risk with the party that has a comparative economic advantage in risk bearing so that the cost of risk is lessened [4].

The two parties are the" indemnitor" (the one who agrees to indemnify or hold harmless) and the "indemnitee" (the one who is originally potentially liable to pay but who has transferred this risk to the indemnitor and can no longer be harmed by the financial burden). Illustrative examples include having the owner as the indemnitee and the general contractor as the indemnitor, or it could be a contractor as the indemnitee and subcontractor as indemnitor.

As an illustration of the incentive effects, an electrical subcontractor has best control over how the wiring in a construction project is performed. Faulty wiring however, could cause a financial loss for the contractor, such as if a third party was injured and sued the contractor. If the contractor had the subcontractor sign a hold

harmless agreement, then the subcontractor has agreed to pay for any harm to the contractor caused by subcontractor's work (within the terms of the hold harmless agreement). The financial consequences of the risk of faulty wiring would be transferred to the party best able to ensure there is no faulty wiring. This hold harmless and indemnification clause ensures subcontractors monitor their own work, as they bear the consequences of their losses.

The type or form of hold harmless/indemnification agreement determines the degree to which the liability associated with the indemnitee's negligence is shifted to the indemnitor. There are three common forms of indemnity (hold harmless) agreements: (1) a broad form, (2) an intermediate form, and (3) a limited or comparative fault form [4, 20].

First, the broad form transfers the most incurred risk (financial responsibility) from the contractor (indemnitee) to the subcontractor (indemnitor). With this broad form agreement, the subcontractor agrees to take on all related liability for accidents whether it be due to their own negligence, negligence by the contractor, or a combination of negligence on the part of both. Due to its broad scope, the subcontractors must usually get an additional insurance policy on top of their own liability policy. Note also that since the subcontractor with this type hold harmless form has agreed to take on the contractor's liability, even that which had nothing to do with the subcontractor; there is an adverse incentive for safety created for the contractor to take care and spend money on safety in the workplace. Therefore, some jurisdictions have declared the broad form illegal.

The second intermediate type of hold harmless agreement has the subcontractor (indemnitor) assume responsibility for all loss costs except those arising solely from the contractor's (indemnitee's) negligence. This is the most common hold harmless agreement type. If both the subcontractor (indemnitor) and the contractor (indemnitee) are partially negligence the subcontractor is responsible for all liability.

The third limited form hold harmless agreement holds the subcontractor (indemnitor) responsible only for their part of the liability and the contractor (indemnitee) is responsible for his or her part. This is a comparative fault form, as determination must be made as to what percentage of the liability was the fault of the subcontractor and what was due to the contractor [20].

It should be noted that the party agreeing to assume the liability of another under a hold harmless agreement might, but does not automatically, have recourse to their CGL policy to cover their contractually assumed liability. The 2013 CGL policy has a "contractual liability exclusion" that eliminates an assumption of such risk within the liability section of the CGL unless it is for a liability that the insured would have had even without having signed a hold harmless agreement, or unless it was for a liability assumed in a contract or agreement that is an "insured contract." The meaning of this last term continues to be litigated, and it behooves the contractor to consult their broker for what parts (if any) of the hold harmless agreement can be covered by the CGL. Court rulings have differed by state [21]. Many conclude that the hold harmless agreement is an "insured contract" and hence is excluded from this policy exclusion (and therefore is included in the CGL coverage).

5. Surety bonds for construction projects

Like insurance, surety bonds exist to ensure that a construction project is completed within the contract's terms and conditions. Most surety bonds are underwritten by sub-divisions of insurers, and like insurance, surety bonds are regulated at the state level in the USA by the state's Department of Insurance. Surety bonds are not insurance, however, but rather provide a guaranty that the obligations of the

contractor will be fulfilled. The Surety (the entity writing the bond) can assist the contractor if the contractor experiences cash flow problems. If the contractor fails to perform or is held in default of the contract, or abandons the project, the Surety may replace the contractor to get the project completed.

Unlike insurance, written to cover unexpected fortuitous events that affect the project and that indemnifies the insured and provides legal defense of the insured under the policy, a surety bond is written to cover the contractor's obligation to the owner under the contract and does not provide any legal defense for the contractor. An insurance contract has a specific period for coverage and is renewable whereas a surety bond is generally project specific and lasts throughout the project. If an insurer makes a payment on behalf of the contractor, the contractor is not expected to reimburse the insurer, whereas if a surety bond provider makes payments on behalf of the contractor, the contractor must pay them back. Because the underwriting of the bond involves contractor prequalification based on their construction experience and financial strength, the bond is usually underwritten with the expectation of no loss. When used in construction, surety bonds are called Contract Surety Bonds [8].

Unlike an insurance contract, which is between two parties (the insurer and insured), the surety bond involves three parties: the Obligee (project owner or contract beneficiary), the Surety (who writes the bond and promises performance of the contract), and the Principal (contractor who contracted to construct according to the contract).

Three types of Contract Surety Bonds are most relevant in construction. These are (1) the "bid bond" which protects the Obligee should the contractor be awarded the contract and then either does not sign the contract or does not provide the called-for payment or performance bonds, (2) the "payment bond" that guarantees that the contractor will pay workers, suppliers, and sub-contractors, and (3) the "performance bond" that protects the Obligee from loss should the contractor fail to perform on the construction project according to contract. A Surety assures the project is completed according to contract [8].

Surety bonds are very important for handling the financial consequences of certain risks in the construction industry since many entities require a surety bond from the contractor or sub-contractors as a condition of awarding the contract. For example, general contractors may require their subcontractors to provide surety bonds to protect the contractor. In the public sector, statutory requirements by federal, state and local governments require contractor bonding to ensure the lowest bidder can actually perform on the contract and that suppliers and subcontractors will be paid and taxpayer money be well spent. In the private sector, lending institutions may require surety bonds (and might even become a dual obligee on the surety bond) to protect their investment. Private owners, especially on large projects, may require the contractor provide a surety bond to guarantee the quality of the contractor (since they are pre-qualified as discussed previously) and to make sure their project gets accomplished according to plan in the event of contractor default of failure.

6. Emerging market technologies affecting construction risk

There are many emerging risks dues to world dynamics and risks in the market. Construction managers will likely have to respond to these in their risk management processes or pay the consequences. Some insurance providers already have products to address these. Through the use of insurance providers, such as Lloyds of London, construction managers can negotiate new insurance products that

meet their specific emerging risk management needs or choose to self-insure. This section is forward facing to identify some emerging risks that demand construction management attention before the risks are devastating.

The construction industry is one of the least automated industries, relying heavily on human labor. There are, however, different types of construction robots now poised to revolutionize parts of construction. The use of construction robots can increase efficiency and decrease cost, but also can create risks and uncertainties relatively unfamiliar to construction risk management [22–24].

One potentially disruptive technology is 3D-printing that can build even large buildings on demand. A robotic arm controls a 3D-printer and this 3D printer produces an entire building (or component parts needed for construction). This technology has been used for canals and bridges, with a 3D printed canal built in Netherlands in 2014, and the first ever-3D printed pedestrian bridge built in Spain in December 2016 [24].

Robots may dramatically improve the speed and quality of construction work [22–24]. It was announced recently that Sunconomy, a USA construction company, received permits to build its first 3D printed manufactured house in Lago Vista, Texas [25]. WinSun, a Chinese construction company, expects up to a 50% savings on housing construction using 3D printing [26].

All forms of construction robots could fundamentally change risks, from risks associated with injuries, to project completion time, to supply chains [27]. However, two areas of liability exposure may arise: products liability and intellectual property violations (the 3D plans used).

Contractors using 3D printing should check their CGL policy as many have exclusions for cyber related risk and may exclude liabilities associated with embedded software errors that cause product defect loss when using 3D printing. Contractors should consider getting a version of products liability insurance to cover these losses. Insurance risk transfer issues associated with this emerging technology are discussed in [28]. Demolition robots are another robot that, while slower than demolition crews, are safer and cheaper [29] but create liability.

Emerging AI based applications can be very beneficial to construction. These include: AI innovations providing enhanced visual processing using videos of worksites to help identify safety hazards, drones, high tech sensors and other enhanced visual processing to automate tracking of project progress against plans, as well as 3D models from data captured by drones to measure progress against original designs, and to detect any errors or inconsistencies [30].

In spite of these and other benefits of AI and tech innovations, they do create liability transfer risks still not well identified or addressed. These insurance liability transfer risks are very complex and the party responsible for AI and innovation failures causing damages have yet to be legally decided [31]. Cyber liability exclusions in the CGL may cause lack of coverage issues and it is important for construction managers to recognize and deal with these risks.

7. Conclusion

There are many risks in construction necessitating decisions to avoid, retain or transfer an identified risk (The A-R-T of Risk Management) that ideally should be made in the planning phase before project start. This chapter delineated characteristics of construction risk and focused on ways to transfer financial risk to the insurance market, to other stakeholders, to retain or to avoid that part of the business creating the risk.

A contractor's goal is to minimize the cost of risk, so alternative risk transfer methods were discussed, from well-established ones to emerging ones. Builders can contractually transfer risks to involved others or clients (e.g., through hold harmless agreements) or to insurance companies. The marketplace is dynamic, and transfer options for construction risks are continually evolving.

This chapter looked forward and discussed emerging technologies that will be creating new risks to anticipate (e.g., the advent of 3D printing, robotics, and AI). Technological advancements will always present new risk challenges.

Finally, issues of sustainability (the ability to have low environmental impact) and resilience (the ability to bounce back from unexpected or catastrophic events) will become increasingly important for construction risk managers. This is partially due to climate change, increasing catastrophic events, and the consequential regulatory changes likely to spur new and challenging building codes. These are among other currently unknown and, as yet unaddressed risks are important for the construction manager to anticipate.

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References

[1] Freedman A. Unquantifiable Exposures: Top Five Uninsurable Risks. Risk & Insurance [Internet]. September 2, 2014. Available from: http://riskandinsurance.com/top-five-uninsurable-risks/ [Accessed: Jan 11, 2019]

[2] Baranoff E, Brockett P, Kahane Y, Baranoff D. Risk Management for the Enterprise and Individuals [Internet]. V2.0. Boston: Flatworld Publisher; 2019. Available from: http://www.flatworldknowledge.com/

[3] Brockett P, Cox S Jr, Witt R. Insurance versus self-insurance: A risk management perspective. The Journal of Risk and Insurance. 1986;**53**:242-257

[4] Witt R. The Optimal Allocation of Insurance Related Risk and Costs in Construction Projects. Austin: University of Texas at Austin and The Construction Industry Institute; 1993

[5] Insurance Information Institute (iii). Facts + Statistics: Workplace Safety/ Workers Comp, Table 10 [Internet]. 2018. Available from: https://www.iii.org/fact-statistic/facts-statistics-workplace-safety-workers-comp [Accessed: Jan 9, 2019]

[6] WorkCompLab. Workers' Compensation Insurance by Industry. 2018. Available from: https://workcomplab.com/insurance-industry/ [Accessed: Jan 8, 2019]

[7] Schofield K, Alexander B, Gerberich S, MacLehose R. Workers' compensation loss prevention representative contact and risk of lost-time injury in construction policyholders [Internet]. Journal of Safety Research. 2017;**62**(Supplement C):101-105. DOI: 10.1016/j.jsr.2017.06.012 [Accessed: Jan 10, 2019]

[8] Muse F, Kneisel C, Robert F. Insurance coverage for construction projects: Chapter 4. In: Cushman R, editor. Construction Business Handbook. New York: ASPEN Publishers; 2003. ISBN-0735536805. Available from: https://www.kilpatricktownsend.com/~/media/Files/articles/Construction%20Business%20Handbook.ashx [Accessed: Feb 25, 2019]

[9] Tarmy J. Who will foot the bill for San Francisco's $750M millennium tower? Insurance Journal [Internet]. 2017. Available from: www.insurancejournal.com/news/west/2017/02/02/440648.htm [Accessed: Jan 3, 2019]

[10] Wertheim J. San Francisco's leaning tower of lawsuits [Internet]. CBS News, CBS Interactive. 2018. Available from: www.cbsnews.com/news/millennium-tower-san-francisco-leaning-tower-of-lawsuits-60-minutes/ [Accessed: Jan 10, 2019]

[11] International Risk Management Institute (IRMI). Contractors Professional Liability [Internet]. 2019. Available from: https://www.irmi.com/term/insurance-definitions/contractors-professional-liability-insurance [Accessed: Jan 10, 2019]

[12] Brockett P, Witt R, Aird P. An economic overview of the excess and surplus lines insurance. Journal of Insurance Regulation. 1990;**9**(2):234-258

[13] Marker S. Delay In Completion Losses Under A Builders Risk Policy. Merlin Law Group, Property Insurance Coverage Law Blog [Internet]. 2014. Available from: https://www.propertyinsurancecoveragelaw.com/2014/07/articles/commercial-insurance-claims/delay-in-completion-losses-under-a-builders-risk-policy/ [Accessed: Jan 11, 2019]

[14] Lerner M. Subcontractor default insurance market set to expand. Insurance journal [Internet]. 2018. Available from: https://www.businessinsurance.com/article/20181218/NEWS06/912325707/Subcontractor-default-insurance-market-set-to-expand [Accessed: Jan 8, 2019]

[15] Wakefield J. When Does Insurance Cover Faulty Workmanship? Construction Litigation Blog, Insurance Blog, James Wakefield, Cummins & White, LLP [Internet]. 2012. Available from: https://www.cumminsandwhite.com/when-does-insurance-cover-faulty-workmanship/ [Accessed: Jan 10, 2019]

[16] Citizens General Insurance Brokers. Does Your General Liability Insurance Cover Faulty Workmanship? [Internet]. Available from: https://citizensgeneral.com/business-insurance-news/postid/69/does-your-general-liability-insurance-cover-faulty-workmanship [Accessed: Jan 11, 2019]

[17] Paperless Insurance. Faulty Workmanship Coverage Endorsement [Internet]. 2013. Available from: https://www.paperless-insurance.com/faulty-workmanship-coverage-endorsement/ [Accessed: Jan 10, 2019]

[18] International Risk Management Institute (IRMI). Contingent Business Interruption: Getting All the Facts [Internet]. 2019. Available from: https://www.irmi.com/articles/expert-commentary/contingent-business-interruption-getting-all-the-facts [Accessed: Jan 10, 2019]

[19] DBH Resources, Inc. Contractors Risk Management Practices, an Educational Guide. 2008. Available from: http://lucienwright.com/Contractors_Risk_Management_Guide.pdf

[20] Rodriguez J. 3 Types of Hold Harmless Agreements and When to Use Them. Small Business. 2018. Available from: https://www.thebalancesmb.com/types-of-hold-harmless-agreement-and-when-to-use-844792 [Accessed: Jan 4, 2019]

[21] Stanovich C. Expert Commentary: Contractual Liability and the CGL Policy [Internet]. International Risk Management Institute (IRMI). 2018. Available from: https://www.irmi.com/articles/expert-commentary/contractual-liability-and-the-cgl-policy [Accessed: Jan 10, 2019]

[22] Robotics Online Marketing Team. Construction Robots Will Change the Industry Forever [Internet]. 2018. Available from: https://www.robotics.org/blog-article.cfm/Construction-Robots-Will-Change-the-Industry-Forever/93 [Accessed: Feb 25, 2019]

[23] IIT Madras Printability Lab. 5 Ways that 3D Printing Is Changing the Global Construction Industry [Internet]. 2018. Available from: https://imprint-iitm.org/3d-printing-changing-the-construction-industry/ [Accessed: Feb 25, 2019]

[24] Honrubia M. 3D Printing and its Application in the Construction Industry [Internet]. 2018. Available from: https://www.ennomotive.com/3d-printing-and-its-application-in-the-construction-industry/ [Accessed: Jan 6, 2019]

[25] Vialva T. Sunconomy to develop 3D printed concrete homes in Texas. 3D Printing Industry [Internet]. 2019. Available from: https://3dprintingindustry.com/news/apis-cor-and-sunconomy-to-develop-3d-printed-concrete-homes-in-texas-146575/ [Accessed: Jan 10, 2019]

[26] Burger R. The Effect of 3D Printing on Global Construction [Internet]. 2019. The Balance Small Business [Internet]. Available from: https://www.thebalancesmb.com/3d-printing-construction-industry-845342 [Accessed: Jan 25, 2019]

[27] How 3D Printing in Construction is Transforming the Industry [Internet]. 2015. Available from: https://contractorsinsurance.org/3d-printing-in-construction/ [Accessed: Jan 25, 2019]

[28] Friedman DJ, Buschmann C. What You Need to Know About 3-D Printing and Insurance [Internet]. 2017. Available from: https://www.industryweek.com/additive/what-you-need-know-about-3-d-printing-and-insurance [Accessed: Jan 25, 2019]

[29] Hooker K. Advantages of Demolition Robots. Concrete Construction [Internet]. 2015. Available from: https://www.concreteconstruction.net/how-to/repair/advantages-of-demolition-robots_o [Accessed: Jan 5, 2019]

[30] Clavero J. Applications for Artificial Intelligence in Construction Management. eSub [Internet]. 2018. Available from: Available from: https://esub.com/applications-artificial-intelligence-construction-management/ [Accessed: Feb 25, 2019]

[31] Kerr M. Artificial intelligence ties liability in knots. Risk & Insurance [Internet]. 2017. Available from: https://riskandinsurance.com/artificial-intelligence-ties-liability-knots/ [Accessed: Jan 25, 2019]